OLOGY DEPT.

POWER

POWER GENERATION, TRANSMISSION, APPLICATION
AND THE ATTENDANT SERVICES IN ALL INDUSTRIES

PUBLIC LIBRARY
APR 2 –

APRIL, 1942

tch nameplate kilowatts to
t war loads. How to get
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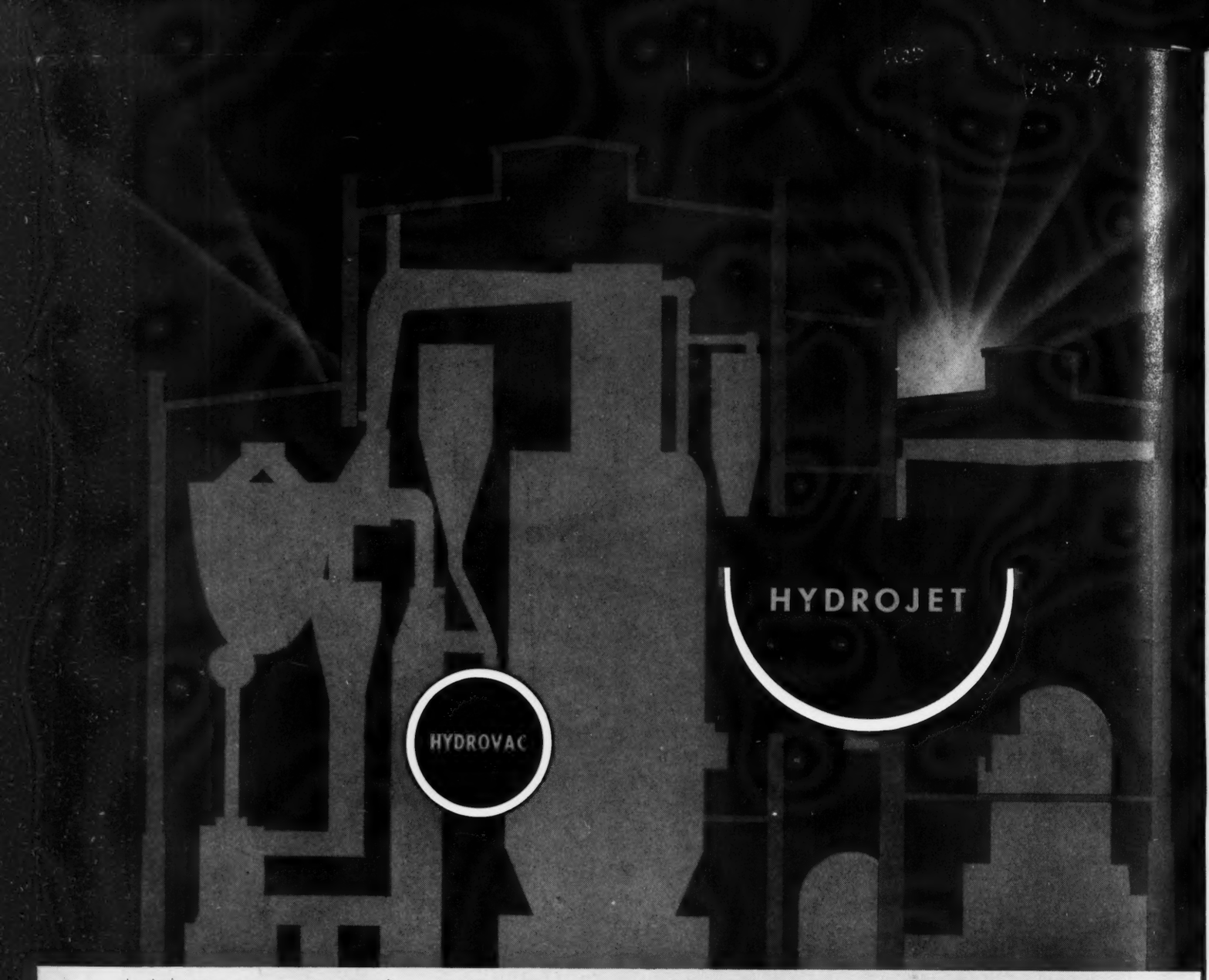
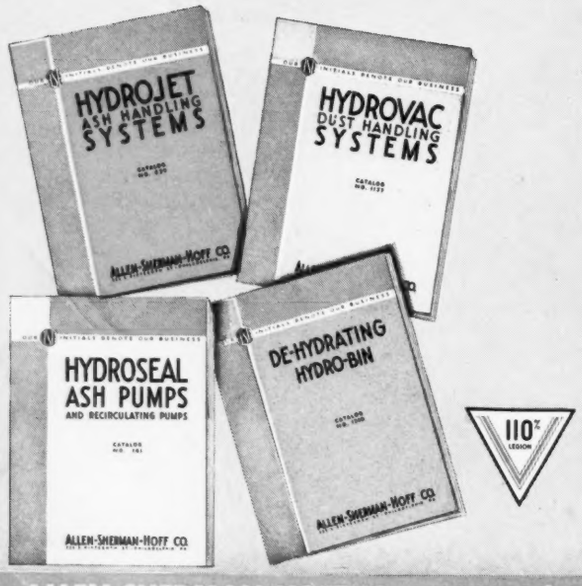


BLACKOUT for Ashes and Dust

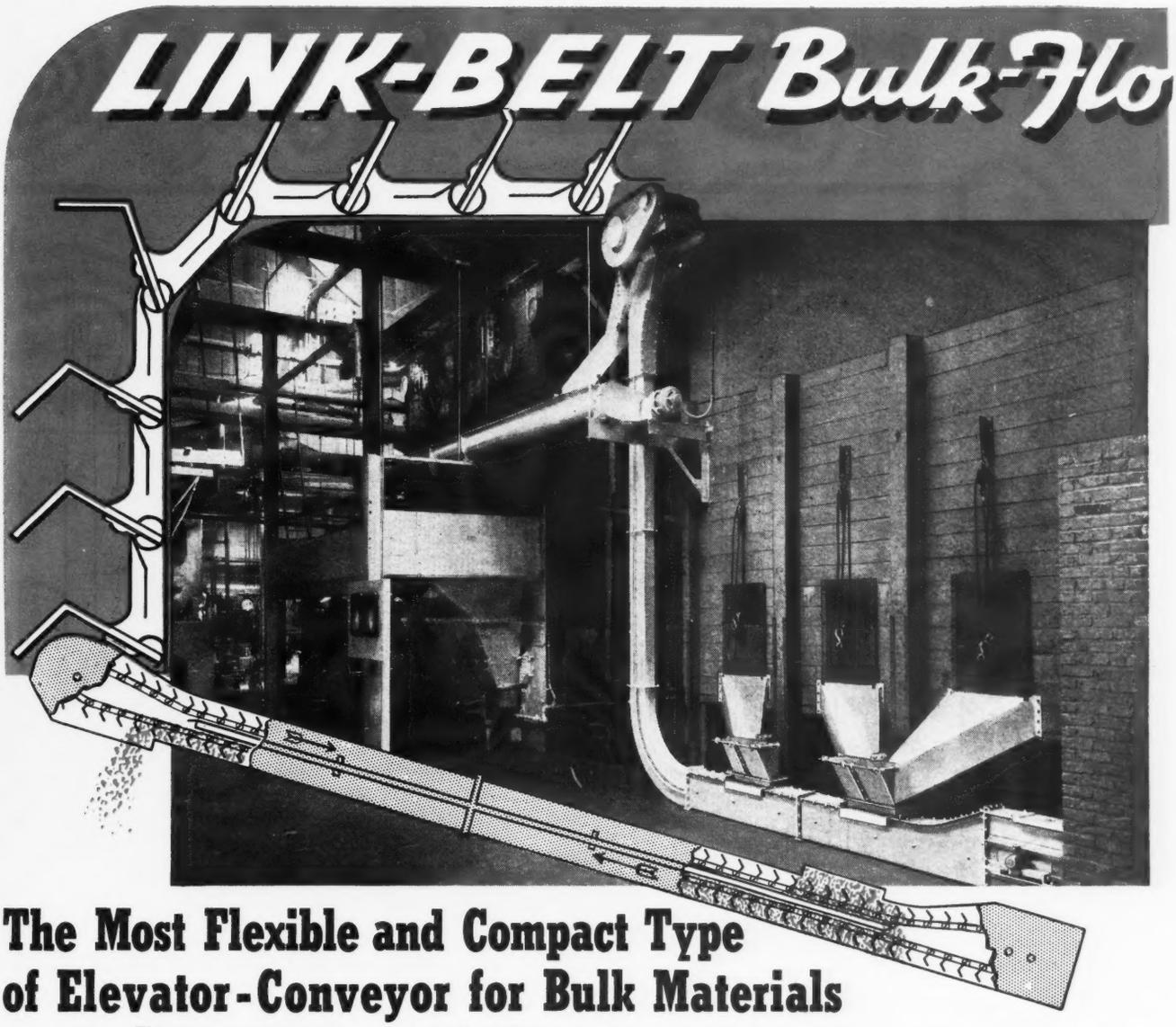


Ashes and dust never see the light until reaching point of final disposal, where the Hydrojet and Hydrovac Systems are used. Sluiceways beneath the floor and pipe lines running to various dust pockets throughout the plant make refuse removal an unseen operation. Generally, the man in charge of the system is the only one in a plant who knows when ashes and dust are being removed, and he doesn't tell by his actions, for he has so little to do. As a result, the plant is free from dust, fog and dirt, ordinarily resulting during ash and dust removal. This same blackout may be extended beyond the building by using a Hydroseal Ash Pump and pipe line pumping the ashes and dust to a Dehydrating Storage Sump, an overhead Hydro-Bin or a distant lowland for fill.

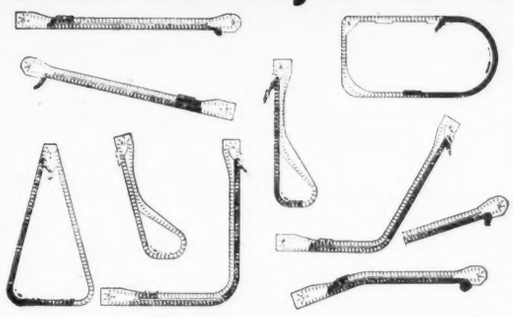
ALLEN-SHERMAN-HOFF CO., 227 S. 15th St., PHILADELPHIA • Offices & Representatives in Principal Cities

POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer," and "The Stationary Engineer"), April, 1942, Vol. 86, No. 4. Published monthly with an additional Directory number in December. McGraw-Hill Publishing Company, Inc. Publication office, 99-129 North Broadway, Albany, N. Y. Editorial and Executive offices, 330 West 42nd Street, New York, N. Y. Entered as second class matter August 25, 1936, at Post Office, at Albany, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, 330 West 42nd Street, New York, N. Y. Subscription rates—U. S. and U. S. Possessions, $3.00 for one year, $4.00 for two years, $5.00 for three years. Canada, $3.50 for one year, $5.00 for two years, $6.00 for three years. Great Britain and British Possessions 36 shillings per year. All other countries $6.00 for one year, $9.00 for two years, $12.00 for three years. 35c per copy.

LINK-BELT Bulk-Flo



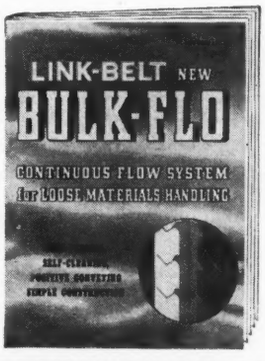
The Most Flexible and Compact Type of Elevator-Conveyor for Bulk Materials



A single Bulk-Flo installation may follow almost any path of travel. Typical arrangements are shown. Because of flexibility for movement in many directions, one continuous unit may be arranged instead of two or more units. In every case you get compact, space-saving design.

Book 1975 has full information

This book contains a complete presentation of the Link-Belt Bulk-Flo with engineering tables and illustrations. We'll be glad to send you a copy.



● The Link-Belt Bulk-Flo conveyor-elevator-feeder cuts handling costs of coal and other flowable, non-corrosive, non-abrasive materials by removing the limitations of alternate methods. It moves materials in compartments, the way a train does; but the "cars" operate in an endless train—horizontally, vertically, on slants of any degree, around corners, in many combinations.

The moving element of the Link-Belt Bulk-Flo conveyor-elevator-feeder is a specially designed chain with peak-shaped cross-flights at each pitch, forming the series of compartments which hold the material. This design gives you automatic feed . . . quick, clean discharge without carry-over . . . smooth, reliable, low-cost operation. Installation requires only a fraction of the space of other conveyors and elevators; and you save also on supporting structure. Extreme flexibility of layout makes possible a simple, low-cost solution to what might otherwise be a complicated, expensive handling problem.

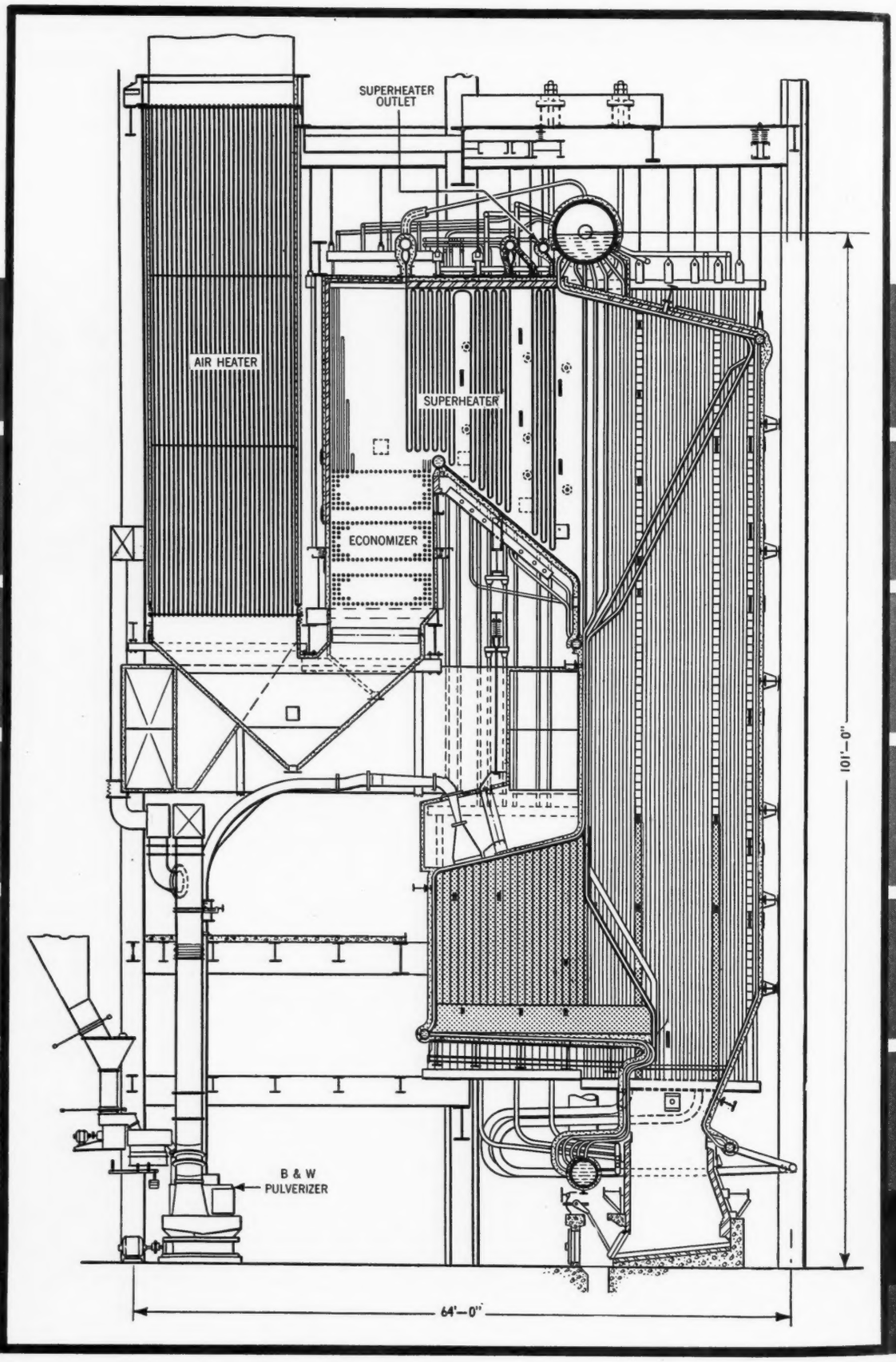
LINK-BELT COMPANY

Engineers and Manufacturers of Materials Handling and Mechanical Power Transmission Machinery Since 1875

Chicago, Philadelphia, Indianapolis, Atlanta, Dallas, San Francisco, Toronto. Offices, warehouses and distributors in principal cities 8769B

The Advanced HANDLING METHOD

52 B & W


SUPERHEATER OUTLET
AIR HEATER
SUPERHEATER
ECONOMIZER
B & W PULVERIZER
101'–0"
64'–0"

Radiant Boilers

ordered to date

21,000,000 lb. steam per hour

Combined Capacity

FUELS—

Pulverized Coal
Oil and Gas
Oil, pulverized coal in future
Gas, oil, or acid sludge, with possibility of pulverized petroleum coke in future

CAPACITIES—

60,000 to 900,000 pounds of steam per hour

PRESSURES—

525 to 1525 pounds per square inch

STEAM TEMPERATURES—

800 to 950 degrees Fahrenheit

THE BABCOCK & WILCOX COMPANY
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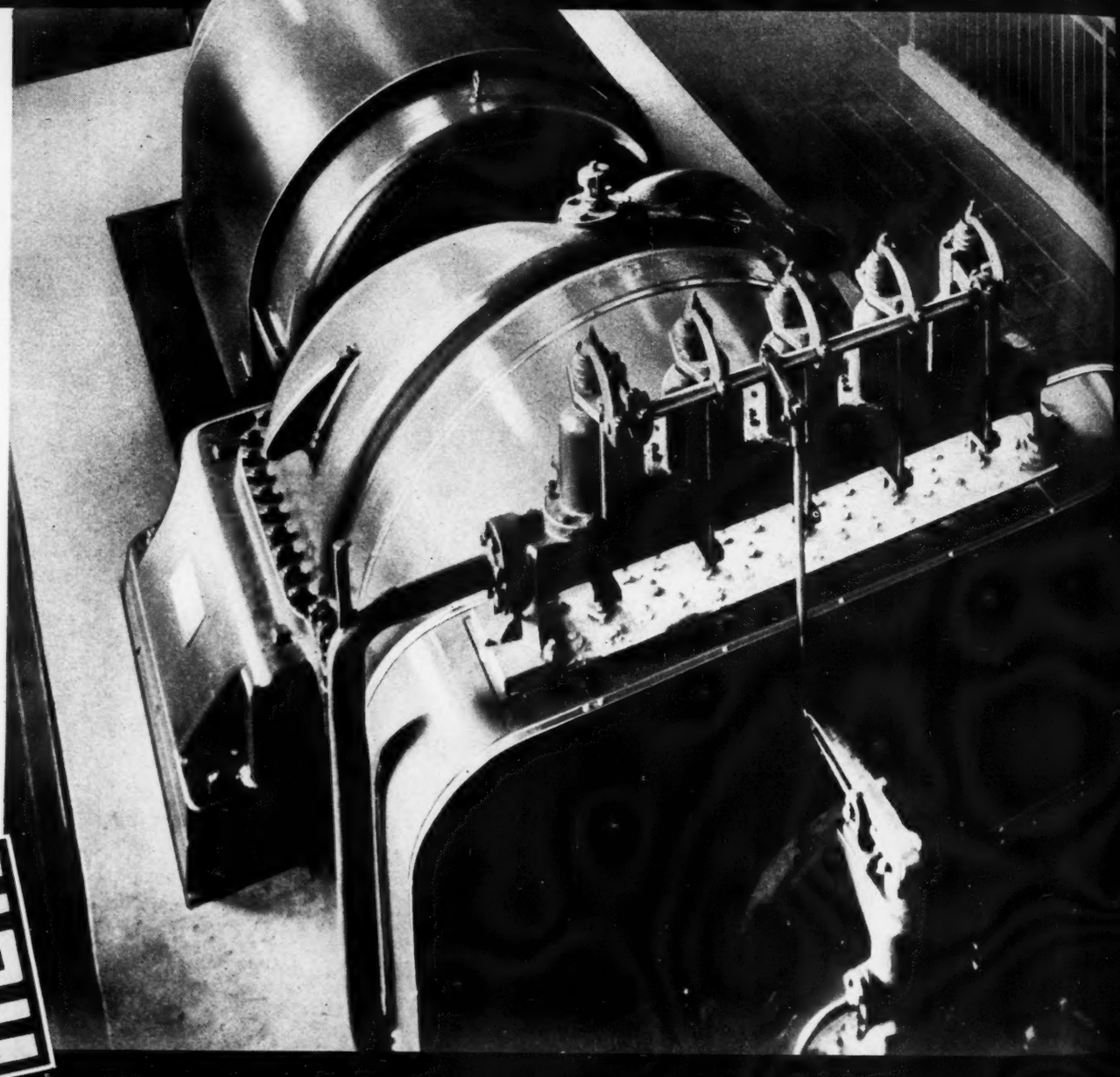
BABCOCK & WILCOX

G-202TA

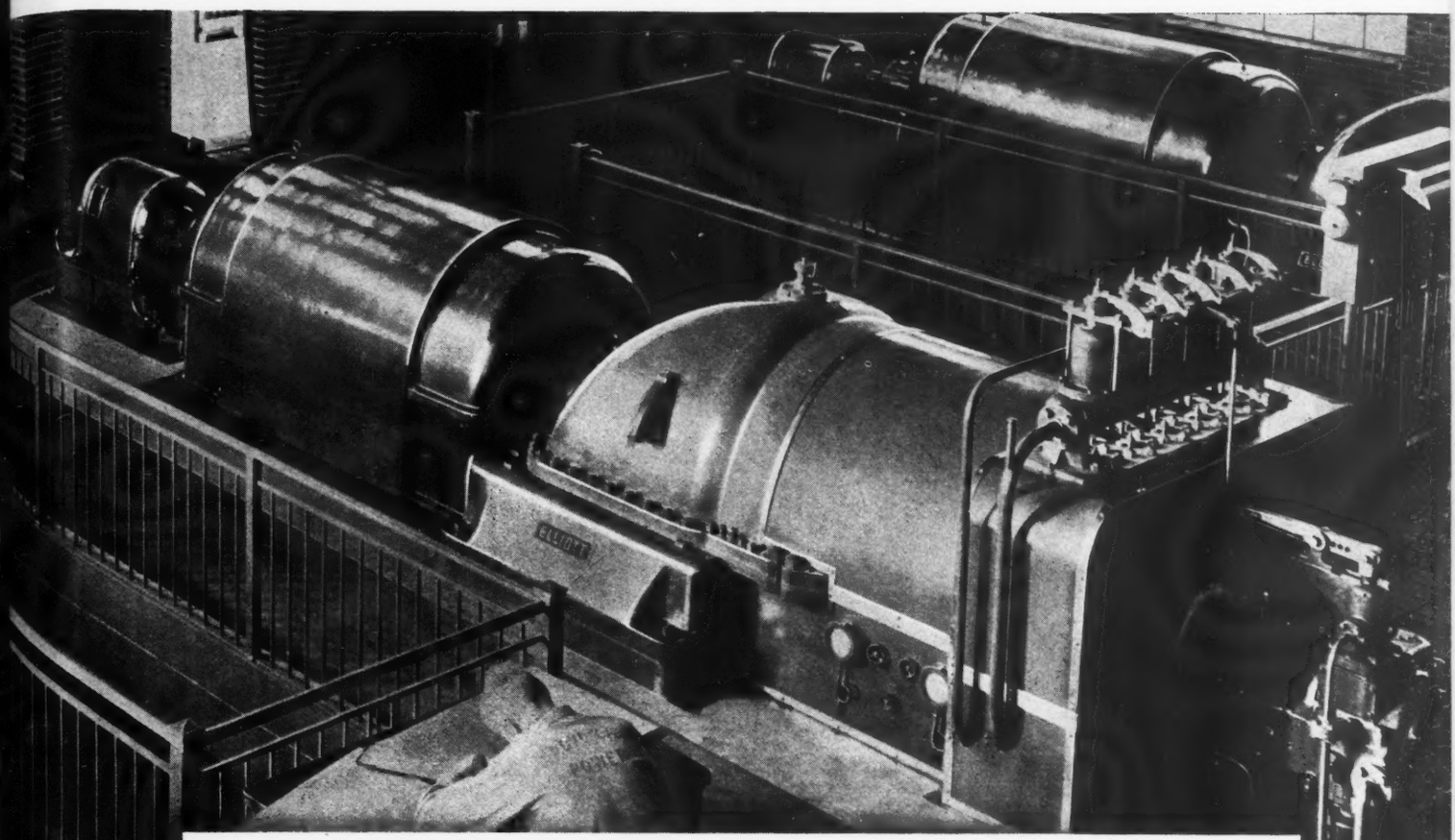
"RANGE TEN THOUSAND MILES— Commence Firing!"



ELLIOTT COMPANY

Steam Turbine Dept., JEANNETTE, PA.

DISTRICT OFFICES IN PRINCIPAL CITIES



THE BIG GUNS OF INDUSTRY ARE POWER GENERATING UNITS. They fire not shells, but kilowatts. Their range is fantastically beyond that of any artillery, for their kilowatts will be felt at the far corners of the earth, in the planes, tanks, ships, guns, which Power builds.

This war will be won by Power. To help win it, hundreds of Elliott turbine-generators like those pictured here, have "Commenced firing" in power plants everywhere. Elliott Company is bending every effort to put on the industrial firing line not only more, but better turbines, generators, and other related power equipment. In the central station shown here, the familiar Elliott monogram is found not only on the three turbine-generator units, but also on the surface condensers to which they exhaust, and on the feedwater heaters which serve the plant.

Elliott engineers are prepared at all times to subordinate all considerations to the vital duty of cooperating in any question of power generation, and to aid to the fullest extent of their ability.

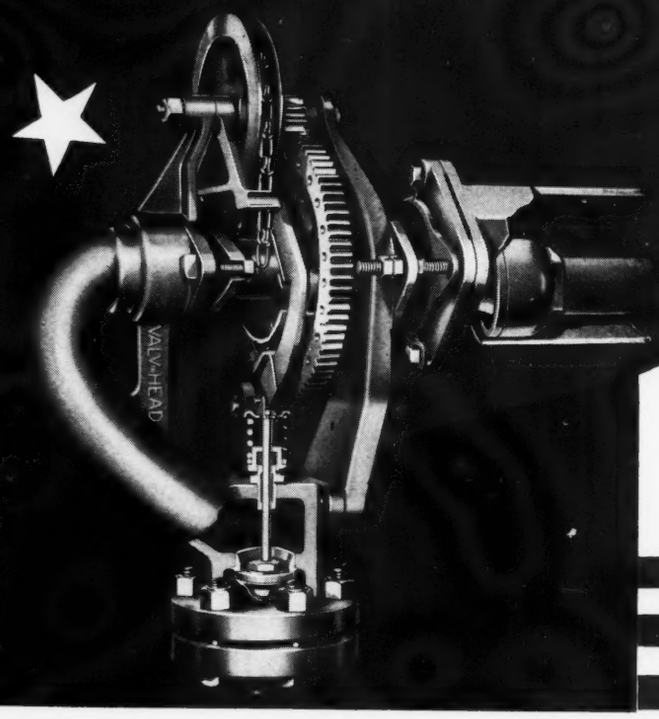
H-655

Equipment on the war path:

TURBINE-GENERATORS • MECHANICAL DRIVE TURBINES • ENGINES
ENGINE-GENERATORS • MOTOR-GENERATORS • MOTORS
GENERATORS • CONDENSERS • STEAM JET EJECTORS
DEAERATORS • FEED-WATER HEATERS • DEAERATING HEATERS
CENTRIFUGAL BLOWERS • TURBOCHARGERS • DESUPERHEATERS • STRAINERS
SEPARATORS • GREASE EXTRACTORS • NON-RETURN VALVES • LAGONDA-LIBERTY TUBE CLEANERS

"ALL OUT"
STEAM PRODUCTION
FOR
"ALL OUT" DEFENSE

By Making Better Use of Your Present Soot Blowers



INCREASED cost of fuel—increased demands for power put boiler efficiency under fire. Boilers must produce these days. "All out" steam production is needed for "all out" defense.

Extra care to take full advantage of your soot blowers is an important part of boiler efficiency.

If your boilers are equipped with Diamond Soot Blowers—as are more than 80% of the modern boilers—you will find them particularly responsive to just a little extra attention. They are as nearly neglect proof as a machine can be made, but any machine is better for care.

Regular periodic inspection, and lubrication keeps them in "fighting trim". A regular daily blowing schedule enables them to keep your boilers clean —and steaming at highest efficiency.

Diamond service men make calls for inspection and adjustment of all Diamond Soot Blowers on water tube boilers—without charge to the user. When the Diamond service man makes his next visit to your plant, ask his assistance in establishing these regular, useful procedures.

DIAMOND POWER SPECIALTY CORPORATION • *Detroit, Mich.*

DIAMOND SPECIALTY LIMITED • Windsor, Ontario

DIAMOND SOOT BLOWERS

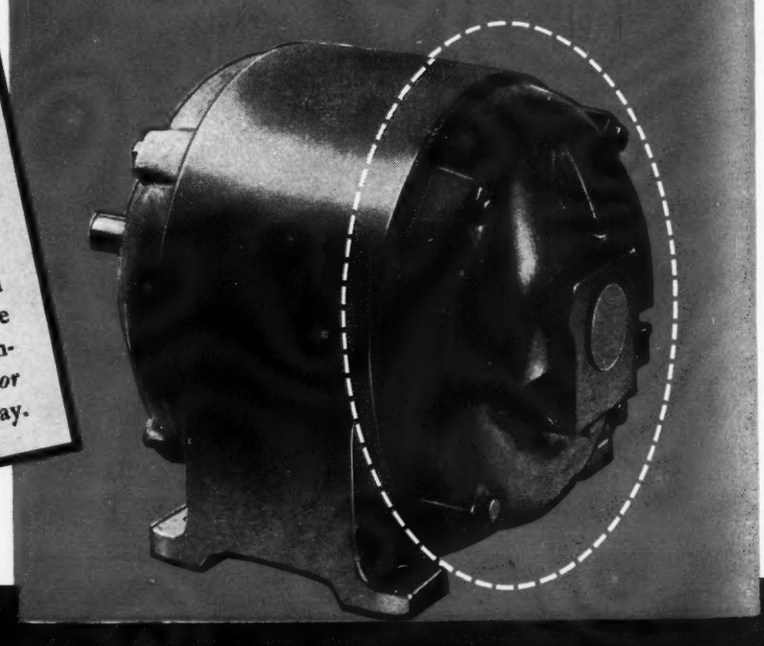
LOOK at the BEFORE YOU BUY!

SEE HOW
"Safety Circle"
GIVES YOU
PROTECTED ENCLOSURE
OF ALL VITAL PARTS
Look at the "broken-circle" design of other motors with exposed undercarriage and incomplete protection. Compare this to "Safety-Circle" construction that guarantees *all-around protection* of vital parts.
Acting as an anchored shock absorber, it gives the entire structure of the motor and all its parts high resistance to blows, knocks, falling objects — keeps your motor in factory-fresh condition for its entire life under normal operating conditions.
To foremen, superintendents, and maintenance men it means more service and smoother operation with less maintenance and lower costs—*more motor for your money* in the Allis-Chalmers way.

Allis-Chalmers New Lo-Maintenance Motor With "Safety-Circle" Protection Gives You All-Around Protection . . . More Dependable Power For Your War Production Needs!

IT'S NEW . . . it's different . . . it's ready NOW when it's needed most! Allis-Chalmers NEW Lo-Maintenance Motor with "Safety-Circle" protection gives you all-around enclosure of vital parts!*

Other motors may be "protected," but just compare them with "Safety-Circle" protection — complete, all-around protection that extends underneath as well. To foremen, superintendents and maintenance men this means more service and



ALLIS-CHALMERS LO-MAINTENANCE

BOTTOM

smoother operation with less maintenance and lower costs — more motor for your money in the Allis-Chalmers way!

The "Safety-Circle" is a wide, integrally cast rib that forms an unbroken circle of protection around the stator chamber . . . acts as an anchored shock absorber . . . gives the entire structure of the motor and all its parts high resistance to blows, knocks, falling objects.

In covering the bottom of the motor, the "Safety-Circle" keeps out dust and dirt and foreign particles that cause abrasive wear and tear to a motor . . . yet it permits complete ventilation of all interior parts.

From frame to shaft . . . from bearing to bearing the NEW Lo-Maintenance Motor is loaded with dependable power, extra performance to meet today's heavy production schedules. Available in ball-bearing or sleeve-bearing types.

Get the complete story! Write Allis-Chalmers, Milwaukee, Wisconsin, for Bulletin No. B-6210. Or call the engineer in the district office near you.

A 1498

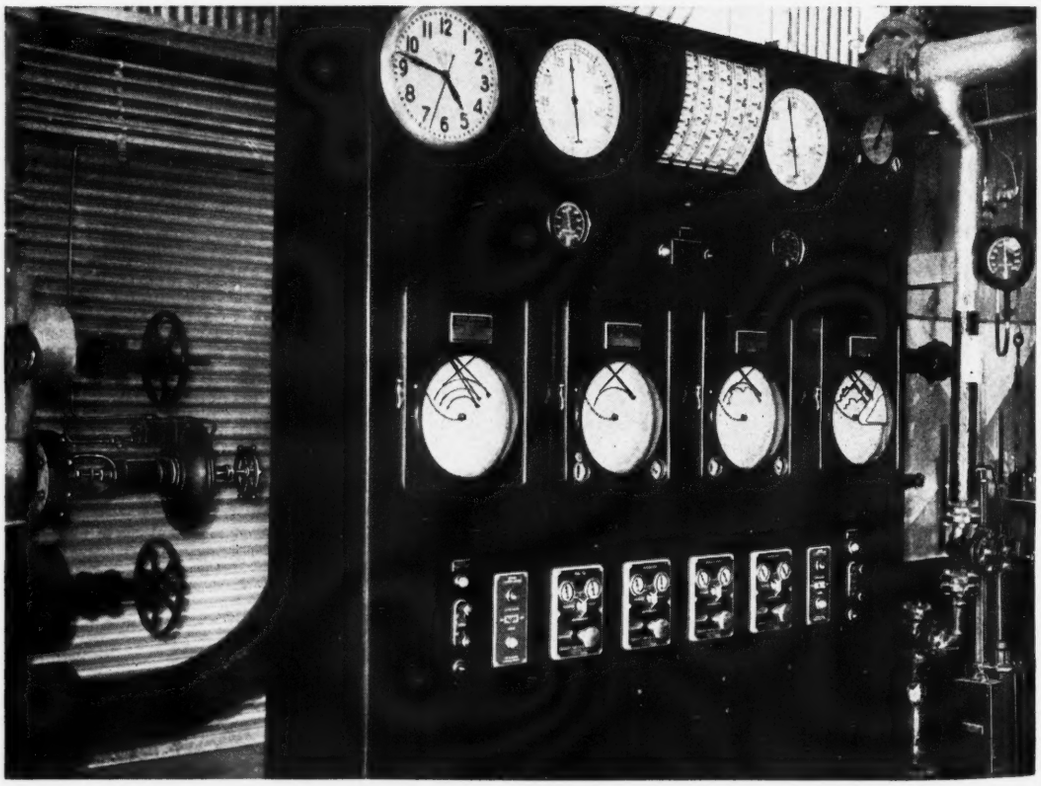
**Don't confuse this NEW motor with higher-priced motors for so-called special purposes. All the extra advantages of this standard motor are yours at no extra cost!*

Extra Protection
IN EVERY PART, TOO!

- Increased cross-strength and inter-phase insulation improves efficiency of distortionless stator.
- Indestructible rotor keyed to shaft, turned to assure accurate, uniform air-gap.
- Improved ball-bearing and sleeve-bearing designs have efficient lubrication features for longer life.
- Oil drains at bottom of bearing for easy flushing, faster maintenance.

MOTOR WITH *"Safety Circle"* PROTECTION

HELP FOR THE BATTLE



These Bailey Meters and Controls insure maximum steaming capacity, minimum "time out" for repairs; and most economical use of fuel in a steel mill and a chemical plant.

BAILEY METER CONTROL . . .

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT

OF 168 HR. PRODUCTION

Production for victory under the 168-hour week will try the soul of many a power plant engineer.

Steaming capacity will have to be stretched to the limit. Shutdowns for maintenance will result in lost production. Certain fuels will not be available and all fuels will have to be used with economy. Trained men will become scarce.

Under these conditions we will have to make the most of what we have. To help power engineers win the battle of 168-hour steam production, Bailey Meter Company has published a bulletin, "How to Safely Stretch Steaming Capacity".

This bulletin makes numerous fundamental suggestions which can be carried out without the use of elaborate metering or control equipment. It also explains how the proper use of metering and control equipment:

1. Stretches steaming capacity.
2. Avoids frequent shutdowns for maintenance.
3. Insures safety of men and equipment.
4. Furnishes data for comparison of fuels.
5. Reduces consumption of fuel.
6. Maintains efficiency while training new operators.

These suggestions will help you win the battle of 168-hour production. Ask for Bulletin No. 16. It will be sent without obligation of any kind.

A-82

BAILEY METER COMPANY
1036 IVANHOE ROAD • CLEVELAND, OHIO
Bailey Meter Company Limited, Montreal, Canada

BAILEY METERS

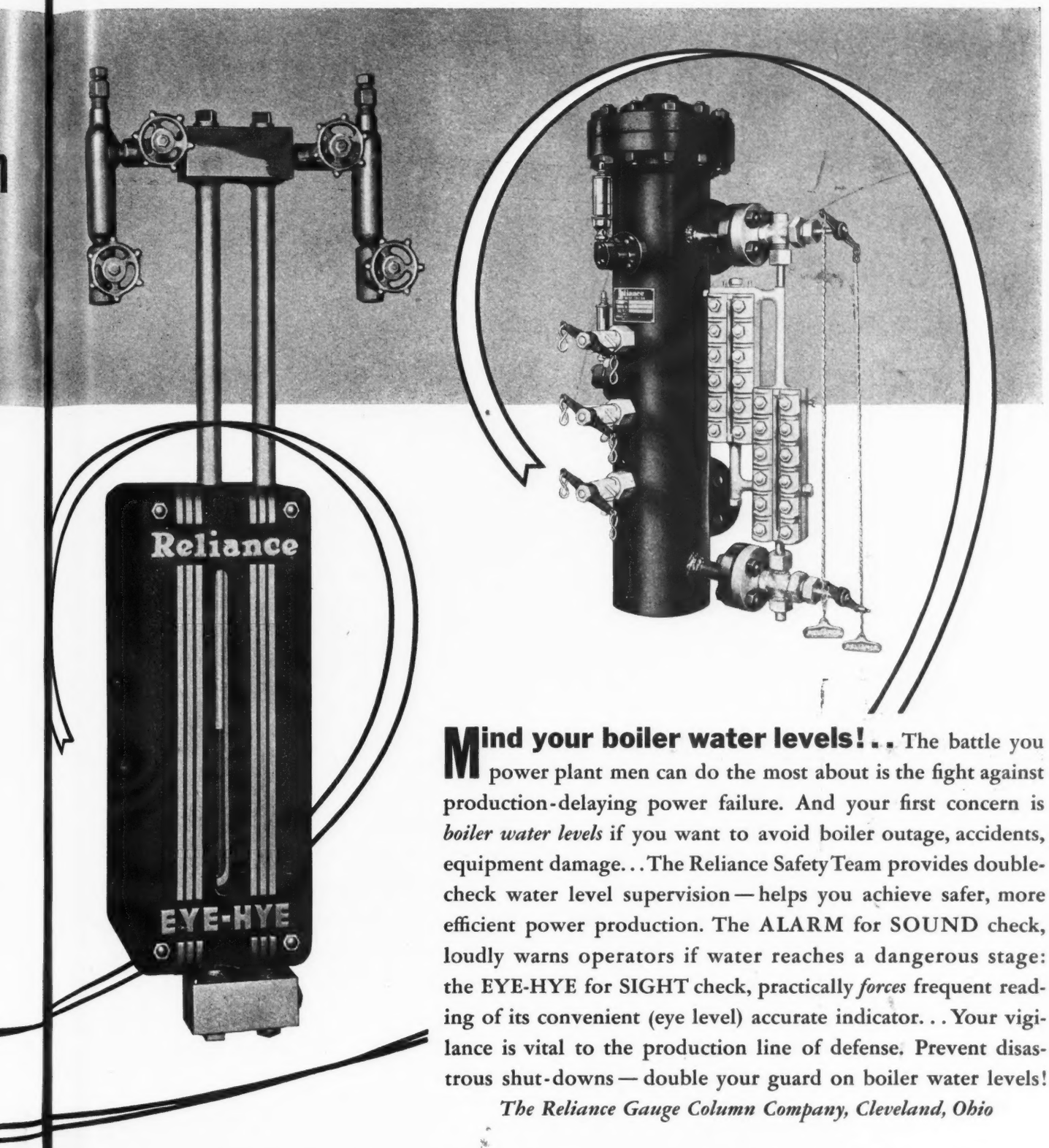
The Complete Combustion Control System

CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

The situation is more than doubly urgent . . .

Double-check the safe operation of your war-essential power plant with the

Reliance



Mind your boiler water levels!.. The battle you power plant men can do the most about is the fight against production-delaying power failure. And your first concern is *boiler water levels* if you want to avoid boiler outage, accidents, equipment damage... The Reliance Safety Team provides double-check water level supervision — helps you achieve safer, more efficient power production. The ALARM for SOUND check, loudly warns operators if water reaches a dangerous stage: the EYE-HYE for SIGHT check, practically *forces* frequent reading of its convenient (eye level) accurate indicator... Your vigilance is vital to the production line of defense. Prevent disastrous shut-downs — double your guard on boiler water levels!

The Reliance Gauge Column Company, Cleveland, Ohio

BOILER SAFETY DEVICES

NEW 2300-VOLT

FOR

Full-voltage starting
Reduced-voltage starting
Reversing
Dynamic braking

OF

Squirrel-cage motors
Two-speed squirrel-cage motors
Wound-rotor motors
Synchronous motors

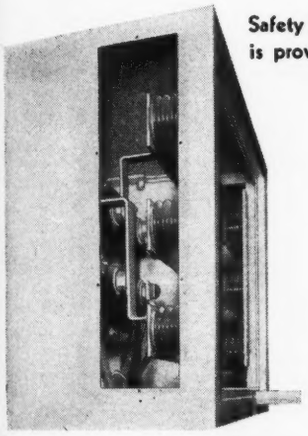
ONE UNIT OR A DOZEN

These starters can be shipped separately or combined in a unit control board consisting of several starters. They are neat in appearance, compact, and easily accessible.

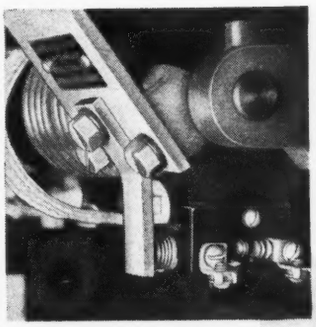
COMBINATION STARTER = **EJ-2 FUSES** + **A MAGNETIC STARTER**

COMBINATION STARTERS

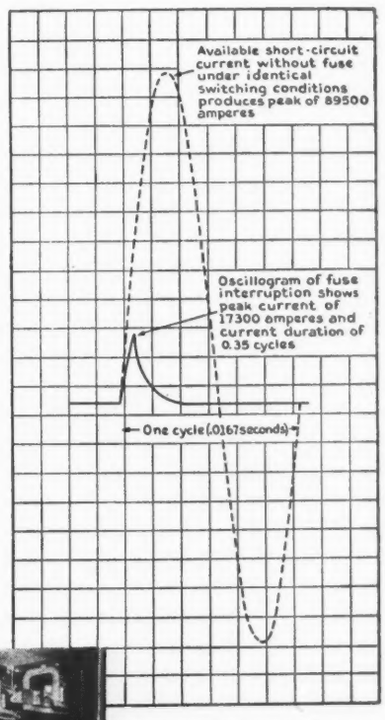
NOW G.E. BRINGS YOU EVERYTHING YOU NEED BETWEEN FEEDER AND MOTOR IN A SINGLE CONTROL UNIT



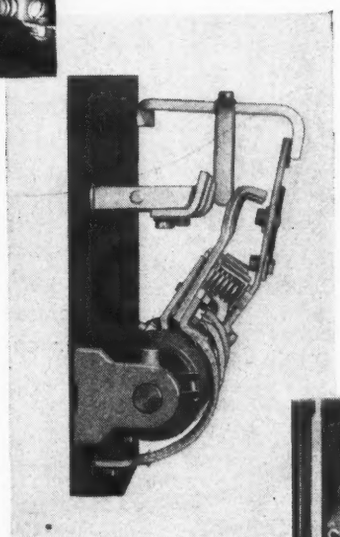
Safety for your operating personnel is provided by enclosed bus bars.



Sturdy, long-life contactor will stand up under millions of operations with only routine maintenance.


Available short-circuit current without fuse under identical switching conditions produces peak of 89500 amperes
Oscillogram of fuse interruption shows peak current of 17300 amperes and current duration of 0.35 cycles
One cycle (.0167 seconds)

Here's what the oscillograph shows about the current-limiting action of EJ-2 fuses (shown at left).



Undervoltage protection is provided by a finger interlock on the contactor shaft.

THIS new G-E combination starter is the only starter available today for 2300-volt service that uses a long-mechanical-life contactor and still provides split-cycle, short-circuit protection.

Everything necessary to completely protect your operating personnel and equipment comes to you in one easily installed, sturdy, steel cabinet. EJ-2 fuses that cut off a short in less than $\frac{1}{4}$ cycle, accurately calibrated overload relays, and an undervoltage protective device are all coordinated to protect your motor without taking it off the line unnecessarily.

Bulletin GEA-3660 gives a well-illustrated description of all the features that make this brand new combination starter tops in the 2300-volt field. Ask our local office for a copy today, or send the coupon direct to General Electric, Schenectady, N. Y.

General Electric and its employees are proud of the Navy award of Excellence made to its Erie Works for the manufacture of naval ordnance.

FOR FURTHER INFORMATION ON THIS NEW SPLIT-CYCLE PROTECTION

General Electric, Section B676-63
Schenectady, N. Y.

I'd like more information about your new 2300-volt combination starter. Please send me Bulletin GEA-3660.

NAME.....

COMPANY.....

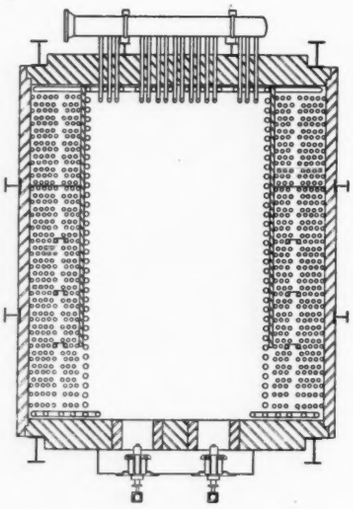
ADDRESS.....

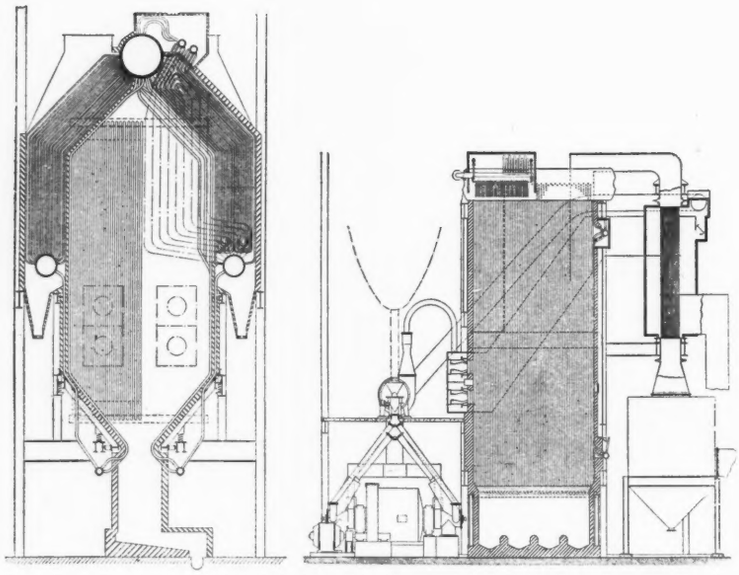
CITY.....STATE.....

676-63-8490

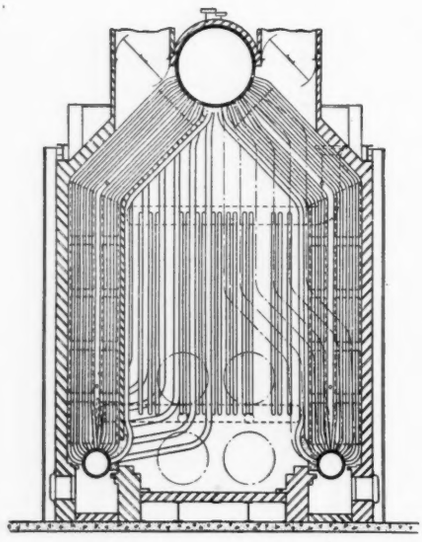
GENERAL ELECTRIC

STEAM GENERATORS





One of the "S-A" type steam generators of the Shell Oil Co. Steam capacity 175,000 lb. per hour. F.S.T. 750° F. Pressure 700 lb. per square inch.



"S-A" steam generator of the Socony-Vacuum Oil Co., Inc. Steam capacity 75,000 lb. per hour. Pressure 160 lb. per square inch.

REPEAT ORDERS

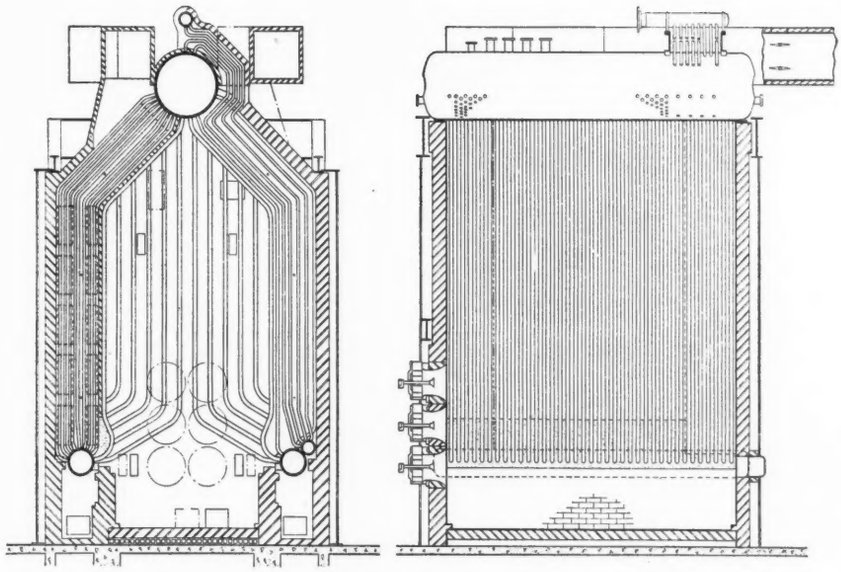
During the last five years more than 160 steam generators have been furnished to the Petroleum Industry by Foster Wheeler—in many countries.

Repeat orders are surest indication of satisfaction as to reliability, efficiency, and over-all costs—44 orders placed by experienced users for additional steam generators is conclusive proof of performance.

FOSTER WHEELER CORPORATION.

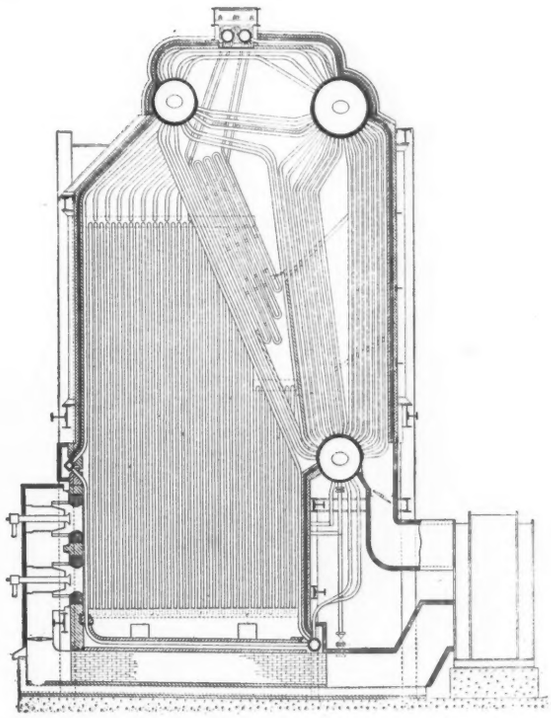
FW FOSTER

FOR THE OIL INDUSTRY



Steam generator of the "S-A" type for a prominent foreign oil refinery. Steam capacity 75,000 lb. per hour. F.S.T. 435° F. Pressure 250 lb. per square inch.

Below: One of the 675 lb. per square inch pressure three drum steam generators for The Texas Company's Port Arthur Refinery. 225,000 lb. per hour at 715 deg. F.—largest outdoor units in this country.

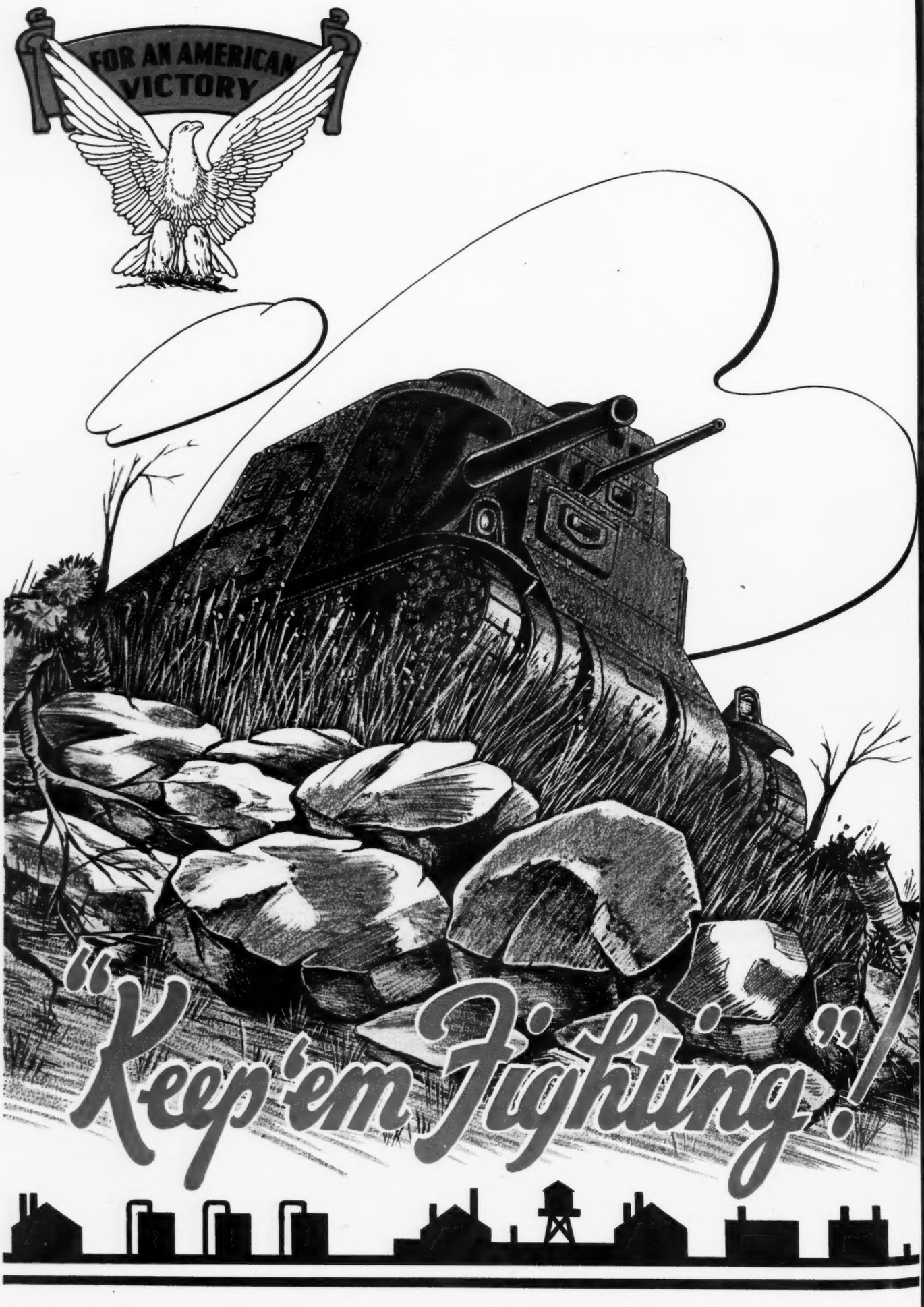


44 YEARS EXPERIENCE

For 44 years Foster Wheeler has sold steam generator equipment to the oil industry. Today, as in the past, we are playing an integral part in the industry's rapid development.

165 BROADWAY, NEW YORK, N. Y.

WHEELER FW


FOR AN AMERICAN
VICTORY
"Keep 'em Fighting!"

LUNKENHEIMER VALVES

ARE HELPING TO BUILD TANKS

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

CINCINNATI, OHIO, U. S. A.

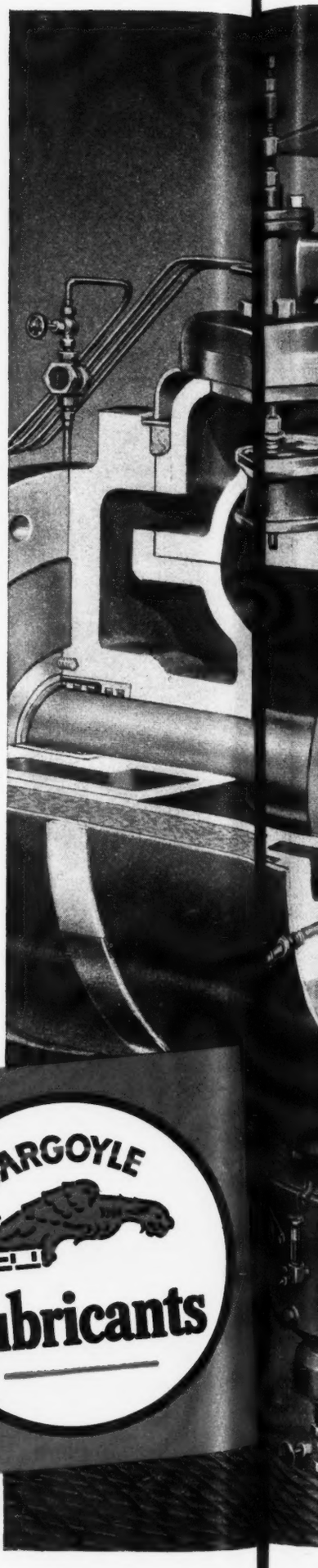
NEW YORK CHICAGO
BOSTON PHILADELPHIA

EXPORT DEPT. 318-322 HUDSON ST., NEW YORK

Your Lunkenheimer distributor has a supply. Ask for your copy.

28-92-4

When It "Groans" It's "Sick"!



BUT EVEN A QUIET-RUNNING JOB DOES NOT ALWAYS MEAN MAXIMUM EFFICIENCY!

Problem: Operating men know that "groans" warn of an engine "sick" from inadequate lubrication. This can result in excessive friction, wear, and blow-by.

Equally important—they know that even a *quiet-running steam engine* may be building up "trouble"... if it's overlubricated. A surplus of lubricant can cause oil in boilers, low heat transfer, danger to tubes and impaired boiler efficiency.

Answer: Use a cylinder oil that will prevent "groaning," yet permit minimum application.

Gargoyle Cylinder Oils fit the bill. They maintain a tough, adhesive film on piston and cylinder walls, even when applied in restricted feeds. And they separate quickly from steam condensate to minimize the amount of oil carried back into the boiler.

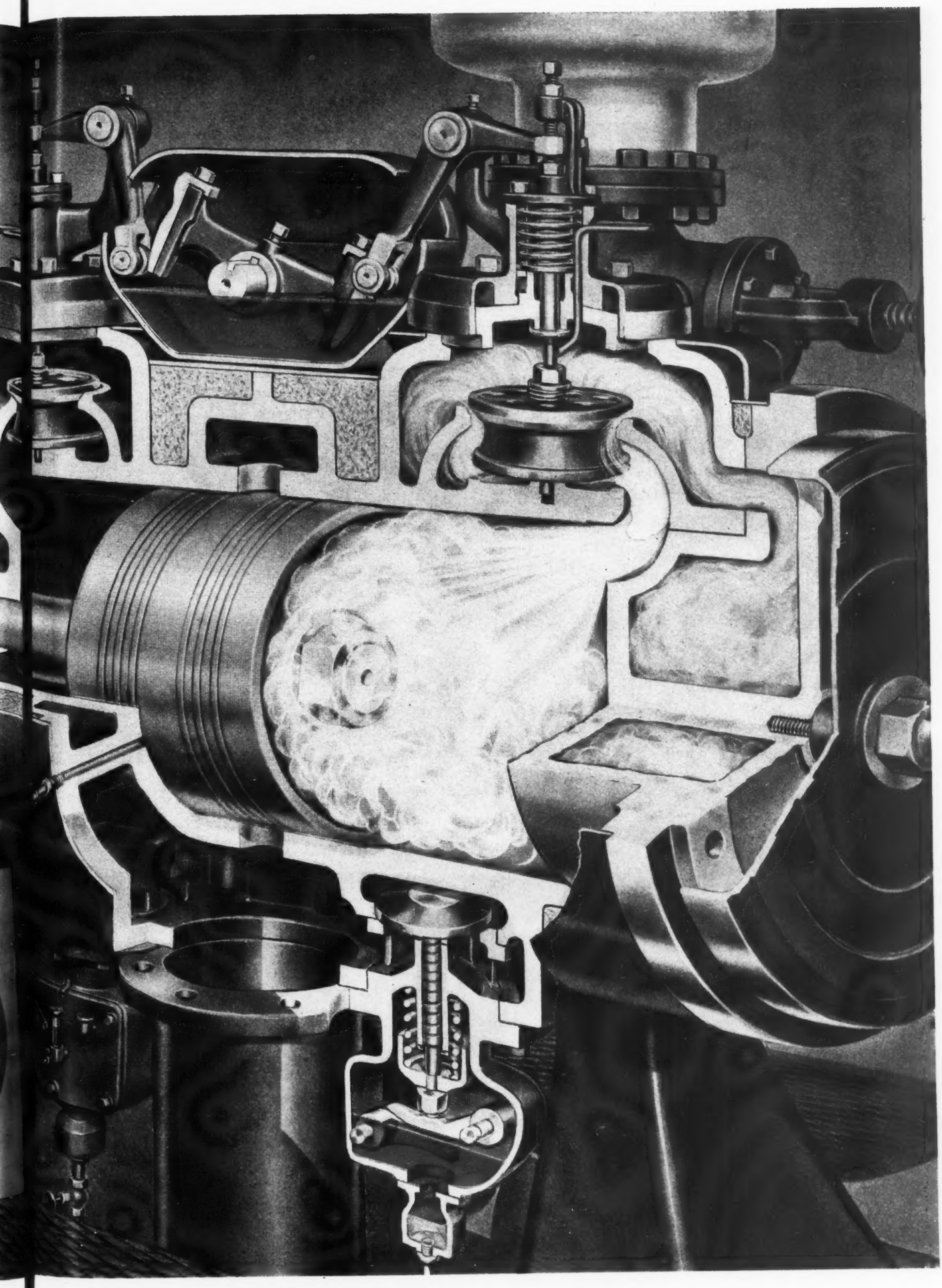
The Socony-Vacuum man who visits your plant can recommend a *correct* Gargoyle Cylinder Oil for your steam engines to fit every conceivable set of operating conditions.

TO HELP MAINTAIN WARTIME PRODUCTION, CALL IN

SOCONY-VACUUM for "Correct Lubrication"

GARGOYLE Lubricants

SOCONY-VACUUM OIL CO., INC. — Standard Oil of N. Y. Div. — White Star Div. Lubrite Div. — Chicago Div. — White Eagle Div. — Wadhams Div. — Southeastern Div. (Baltimore) — Magnolia Petroleum Company — General Petroleum Corporation of Calif.

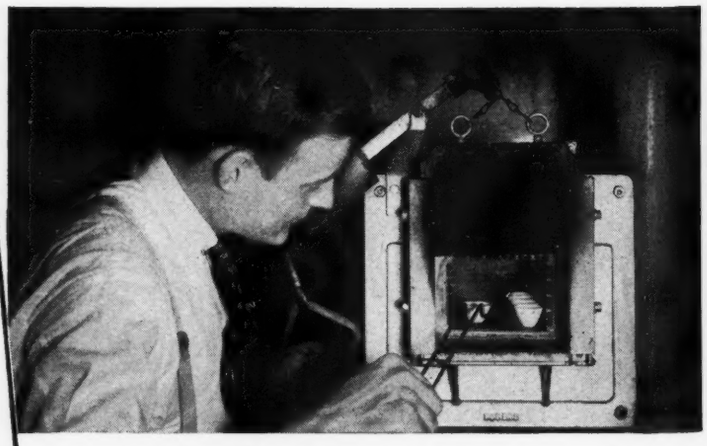


What caused the failure of this superheater tube?

DETAILS OF TUBE FAILURE: Tube evenly thin all around—thickness at bend approximately .076", as against .155" in straight section. Only one tube failed. No burning on furnace side except at localized failure. No furrowing or pitting on inside surface—no distortion—adherent scale paper-thin.

EXTERIOR BURNING?
CARRYOVER?
DEFECTIVE TUBE?
WATER CONDITIONING?

Here's how the answer was found . . .



CHEMICAL ANALYSIS: Main constituents of scale: magnetic iron oxide 63.5%, calcium oxide 21.1%, minor constituents: magnesium oxide 2.1%, silica 0.3%, carbon dioxide 2.8%; no evidence of phosphate.

ON the basis of the evidence presented, what *actually* caused the trouble?

Exterior Burning? No – because no other tubes showed any effect of localized high temperature, thinning was relatively even all around the failed tube, and the failure was very localized.

Carryover? No—because alkaline boiler water concentrating in a superheater develops high causticity and results in furrowing and pitting, not in *even* thinning. Furthermore, the quantity of bright magnetite crystals deposited by carryover is large—much larger than the very thin coating found in this case.

Water Conditioning? No – because no calcium phosphate was present. The thin deposit consisted mainly of magnetite and calcium hydroxide – caused by evaporation of treated water used for filling the superheater when the boiler was off the line.

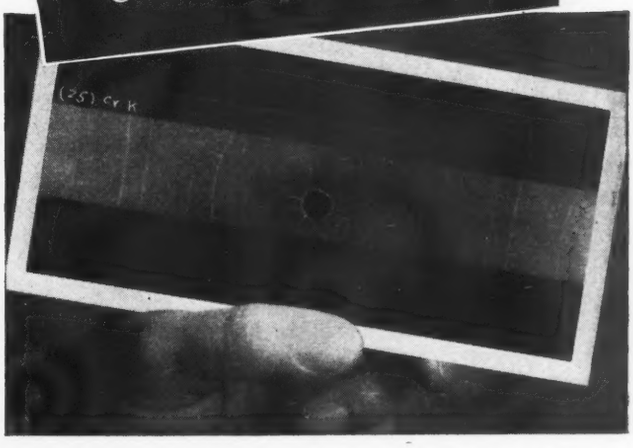
Defective Tube? Yes! Thinness did not develop during operation, as proved by the even thickness of the tube circumference, by lack of distortion from round, and by uniform inside tube-diameter. Thinness developed in the drawing and bending of the tube. The defective condition was original—not caused by the incidents of operation.

• • •

It may seem unusual for Hall Laboratories to search so carefully into the cause of such a relatively simple problem. But when the Hall report on *your* boiler problem arrives, you may be sure that *every* clue has been thoroughly investigated. That is why so many Hall System plants operate continuously *without* unscheduled outages – for years and years and years.

HALL SYSTEM
of Boiler Water Conditioning

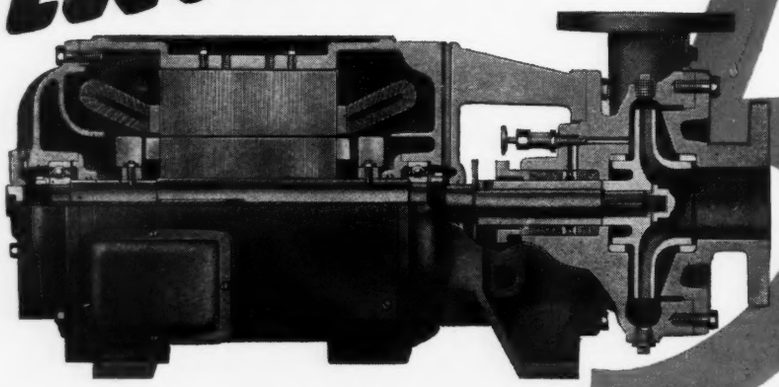
MICROSCOPIC EXAMINATION: Deposit analyzed principally as "black opaque octahedra of magnetite, with some blood-red transparent crystals of hematite and small amounts of calcite." Identification of other constituents rendered difficult by opacity of magnetite.



X-RAY ANALYSIS: Opacity is no screen for penetrating X-rays. Diffraction lines on X-ray film showed "finger prints" of magnetite and calcium hydroxide—no significant amount of any other crystalline constituent.

HALL LABORATORIES, INC. · 309 ROSS STREET · PITTSBURGH, PA.

ALLIS-CHALMERS ELECTRIFUGAL PUMP



5-WAY WINNER!

Allis-Chalmers Electrifugal "One Package" Pumps . . . in Sizes ½ HP to 25 HP . . . Solve Your Wartime Pumping Problems!

BETTER in 5 important ways . . . the new Allis-Chalmers line of Electrifugal Pumps has *everything it takes* to do an efficient wartime pumping job!

Check the points yourself . . . they stack up into 5 big reasons why this pump can give you new highs in pumping performance —

Space saved — up to 33%
Pump Overhang Cut—as much as 40%
2 Section-Fits Eliminated
Splash-proof Motor
Easy-to-get-at Casing

And remember — these points are *in addition* to the regular features that have long made Allis-Chalmers centrifugal pumps tops in the industrial field. Indestructible rotor . . . distortionless stator . . . large, sturdy ball bearings . . . cast bronze protective sleeves . . . and many other extra-value features are yours.

If you have a wartime pumping problem and want *more gallons* with greater *dependability* than you've ever had before, here's the pump for you — for as much as 33% less than the cost of conventional motor and pump installations.

To get the whole story, call the engineer in the district office near you. Or write Allis-Chalmers, Milwaukee, Wis. A 1494

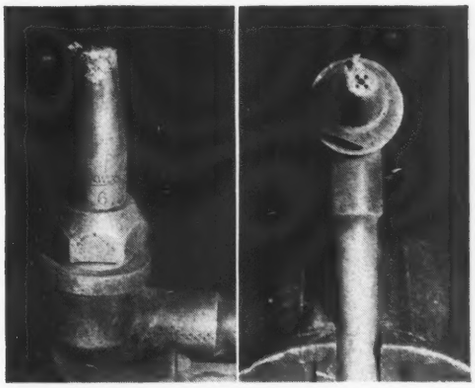
MAKE THIS 3 TO 5 TEST YOURSELF

The NEW Allis-Chalmers Electrifugal Pump has only three section-fits compared to five or more for old style pumps! That means more perfect alignment of the shaft . . . less vibration . . . less wear . . . less trouble. Here's a pump that gives you more gallons . . . for less cost!

Allis-Chalmers Pumps Can Cut Your Pumping Costs

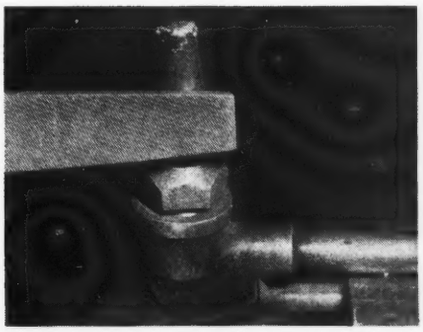
ALLIS-CHALMERS
MILWAUKEE · WISCONSIN

When Oxy-Acetylene Cutting Nozzles Look Like This..*Clean Them*

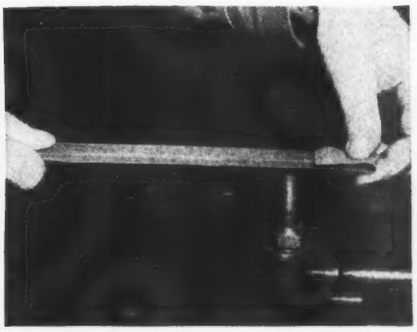


Good results in oxy-acetylene cutting depend upon an accurate flame adjustment, and this requires clean nozzles. In addition to making possible more accurate cutting, correct maintenance will make your nozzles last longer.

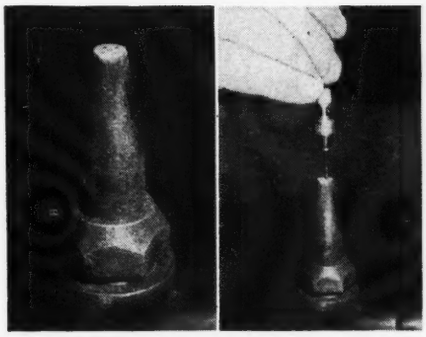
Here's how to do it...



1. Clamp the blowpipe in a vise, inserting a soft material in the jaws to protect the tubes. Knock away loose slag with a file.

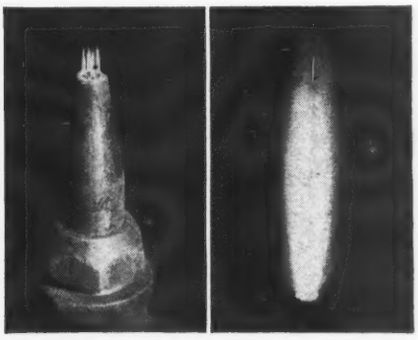


2. Wrap a piece of fine emery cloth around the file and clean the nozzle end so that it is smooth and square.



3. Next take a drill *two sizes smaller* than the size recommended in the instruction booklet furnished with the blowpipe. Work it up and down in the gas orifices. *Do not twist the drill.* Then, using the recommended size drill, repeat this operation.

4. If you do not have the correct sizes of drills, use a piece of copper, or soft brass, wire. A satisfactory substitute drill can be improvised by doubling the wire from a Prest-O-Lite cylinder tag, and then twisting it in a vise until it is tight.



5. After cleaning the nozzle, test the flames by lighting the blowpipe. All of the preheat flames should be the same shape and length, and the cutting oxygen jet should be straight and symmetrical, as shown in the illustrations above.

Instruction Books Available

• You may obtain without charge duplicate copies of the instruction booklets furnished with blowpipes supplied by Linde. Also available is "Precautions and Safe Practices." Write for the copies you need.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

UCC

General Office: 30 East 42nd Street, New York, N.Y.

Offices in Other Principal Cities

In Canada: Dominion Oxygen Company, Limited, Toronto

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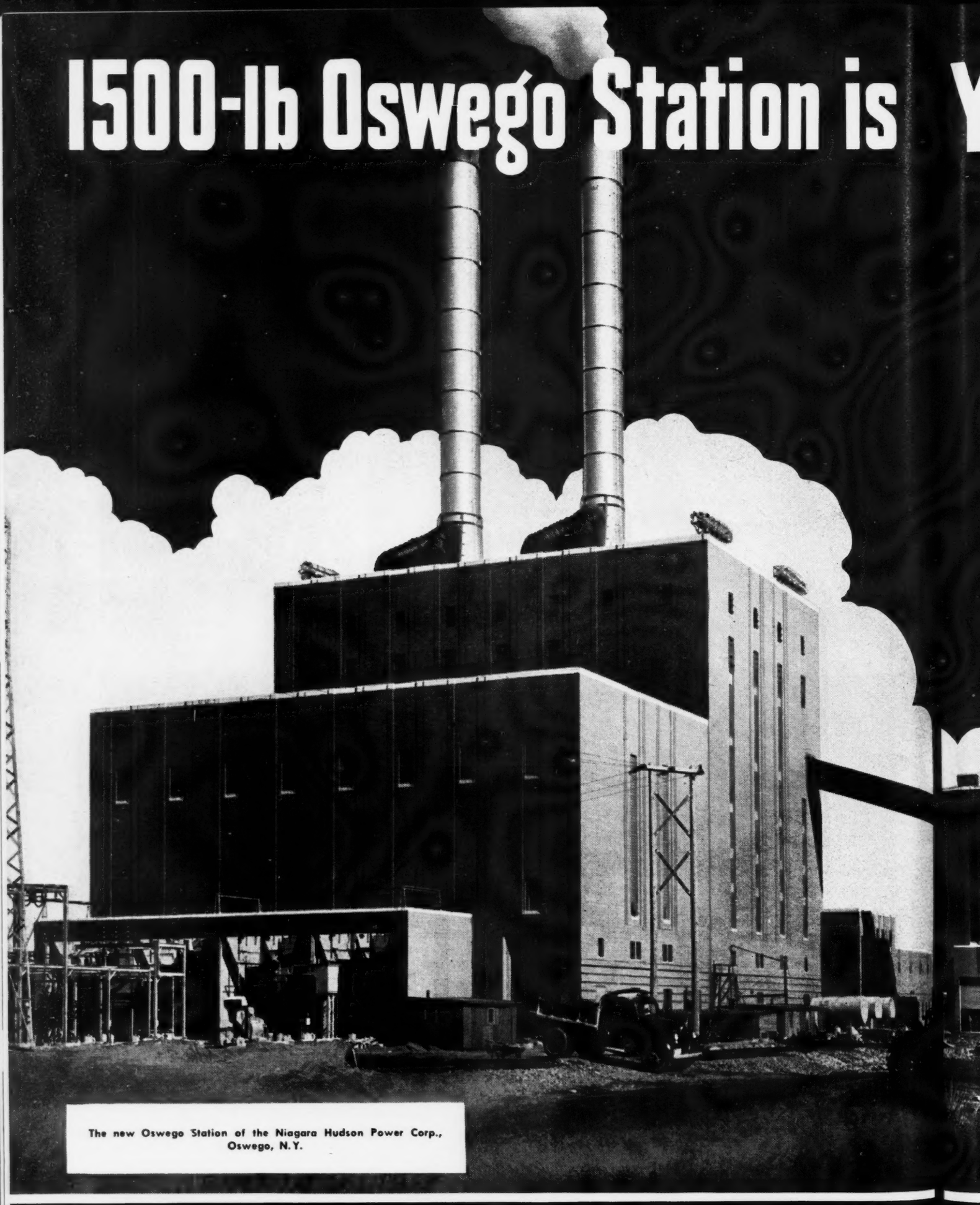
LINDE OXYGEN · PREST-O-LITE ACETYLENE · UNION CARBIDE
OXWELD, PREST-O-WELD, PUROX APPARATUS · OXWELD SUPPLIES

The words "Linde," "Prest-O-Lite," "Union," "Oxweld," "Purox," and "Prest-O-Weld" are trade-marks of Units of Union Carbide and Carbon Corporation.

1500-lb Oswego Station is Y



The new Oswego Station of the Niagara Hudson Power Corp., Oswego, N.Y.

YARWAY

Yarway Unit Tandem Equipped

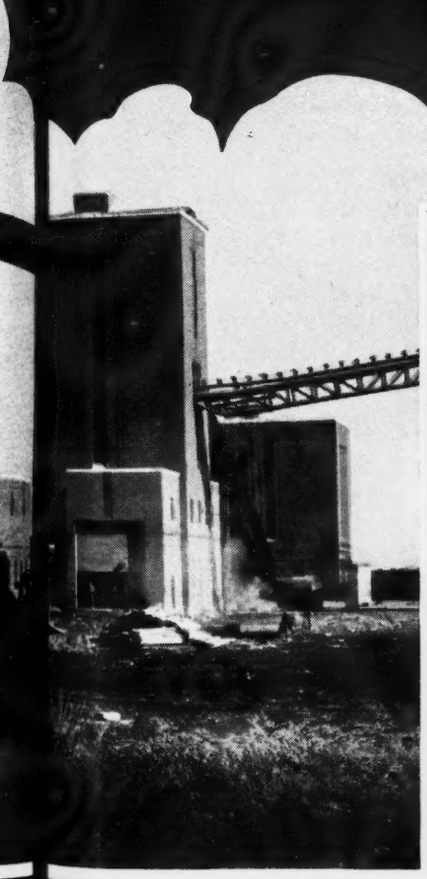
ANOTHER of the many important high-pressure utility stations to select Yarway Unit Tandem Blow-Off Valves for the most difficult of all valve services—the 1500-lb pressure Oswego Station of the Niagara Hudson Power Corp. This installation brings the number of Yarway equipped plants designed for 900 lb pressure and over to ninety-seven.

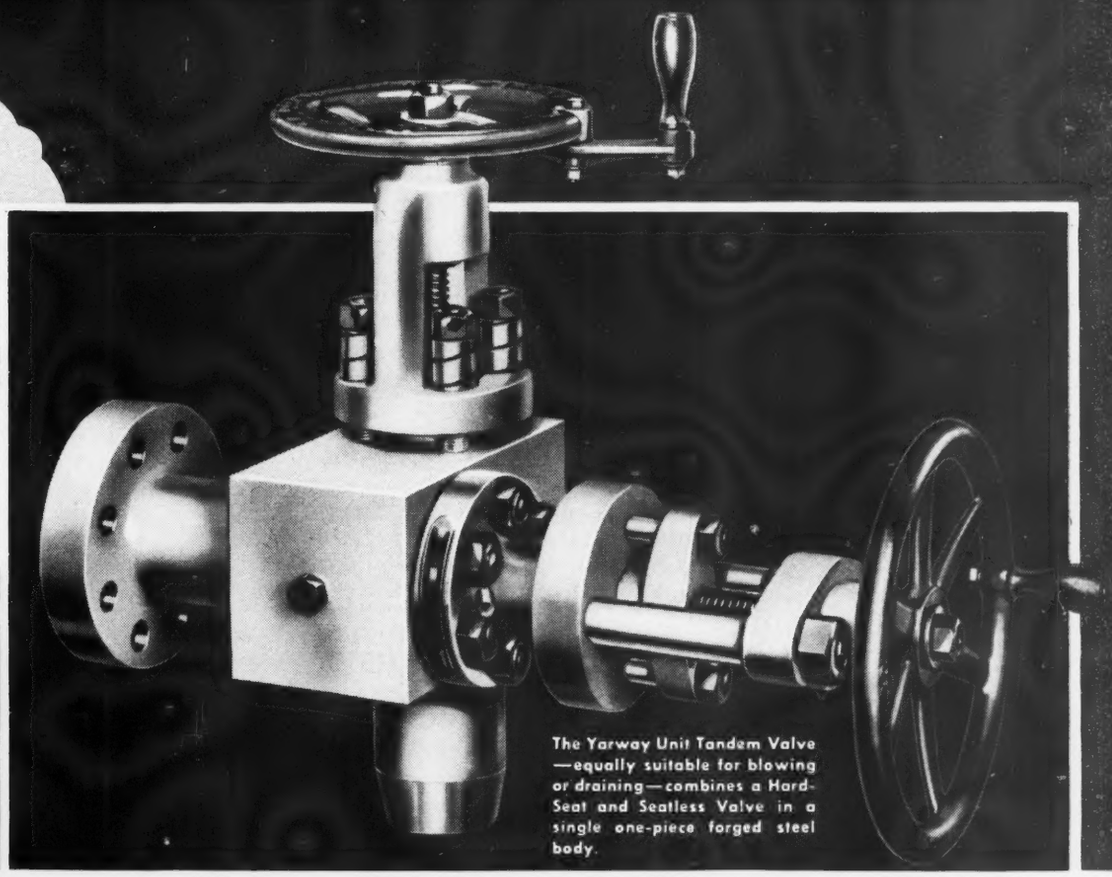
The reason for Yarway's outstanding preference is found in such records as —"*Still tight after 3000 blows at more than 1300 lbs pressure without replacement of a single part or repairs of any nature.*"

Good boiler engineering demands equally sound engineering in the accessories that become part of it. It is not only *protection for your investment, but cheap insurance against trouble and expense.*

Write for Catalog No. 430 for pressures from 400 lbs to 2500 lbs. Catalog 421 for lower pressures.

YARNALL-WARING COMPANY
100 Mermaid Ave. Philadelphia





The Yarway Unit Tandem Valve —equally suitable for blowing or draining—combines a Hard-Seat and Seatless Valve in a single one-piece forged steel body.

BLOW-OFF VALVES

Solve Replacement Problems

by Hard-Facing with Haynes Stellite Rods

AS replacement parts for industrial machines and equipment become increasingly hard to get, it is more important than ever to prolong the life of wearing parts now on the job. In many cases, this can be done most successfully by hard-facing with Haynes Stellite Company rods.

Hard-Face All Parts— Old and New

Old parts which are badly worn can often be reclaimed and armored against wear by applying Haynes Stellite rods. To assure maximum savings, it usually pays to hard-face new parts — *before* wear occurs. Then when long use finally does impair their efficiency, most parts can be hard-faced again and again for added service.

Other Advantages of Hard-Facing

The use of Haynes Stellite hard-facing materials frequently permits use of cheaper base metals—or makes possible the use of a readily available substitute base metal when the usual kind cannot be obtained. When cutting or scraping edges are hard-faced, they stay sharp longer, often reducing power consumption. Time out for repairs is cut down by hard-facing, and this helps maintain high production schedules. At the same time, hard-facing decreases maintenance work and solves many replacement problems. Wherever abrasion . . . impact . . . heat . . . or corrosion . . . take their toll, there's a Haynes Stellite rod to furnish lasting protection.

A Rod for Every Purpose

HAYNES STELLITE ROD—the original non-ferrous cobalt-chromium-tungsten hard-facing alloy—now available in three different grades—high in "red hardness," highly resistant to abrasion and corrosion—applied by oxy-acetylene or electric arc process.

HASCROME ROD—iron-base hard-facing rod containing chromium and manganese—work-hardens under impact—applied by oxy-acetylene or electric arc process.

HAYNES STELLITE "93" ROD—iron-base hard-facing alloy containing more than 40 per cent of alloy ingredients—hard and abrasion-resistant—applied by oxy-acetylene or electric arc process.

HAYSTELLITE INSERTS—cast tungsten carbide in 13 standard shapes and sizes—extremely resistant to abrasion—generally applied by oxy-acetylene process with high-strength steel rod as binder.

HAYSTELLITE TUBE ROD—tungsten carbide grains of 9 standard screen sizes in high-strength steel tubes—extremely wear-resistant—applied as hard-facing rod, generally by oxy-acetylene process.

HAYSTELLITE COMPOSITE ROD—tungsten carbide grains of 4 standard screen sizes uniformly distributed in high-strength steel binder—extremely wear-resistant—applied as hard-facing rod, generally by oxy-acetylene process.

HAYNES STELLITE TRADE MARK

Red hard, wear-resisting alloys of cobalt, chromium and tungsten

HAYNES STELLITE COMPANY

Unit of Union Carbide and Carbon Corporation

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• HEADQUARTERS FOR HARD-FACING MATERIALS •

"Haynes Stellite," "Haystellite" and "Hascrome" are registered trade-marks of Haynes Stellite Company.

HERE'S WHY

TEXROPE* SUPER-7 V-BELTS ARE 4 WAYS BETTER!

1. **50% STRONGER CORDS!** Sensational new Flexon process makes cords 50% stronger than even those in former great Texrope belts.
2. **20% MORE CORDS!** Count them! You get 20% more of these tough, extra pulling power cords in every Texrope Super-7.
3. **INCREASED LIFE!** Cords float on amazing cool-running cushion rubber that absorbs shock . . . actually increases belt life phenomenally.
4. **EXTRA PROTECTION!** Exclusive duplex-sealed cover protects pulling cords against dirt, grit, moisture, and other adverse elements.

FOR FULL wartime production it is vital that power . . . *and power transmission* . . . be at their very peak of efficiency in your plant!

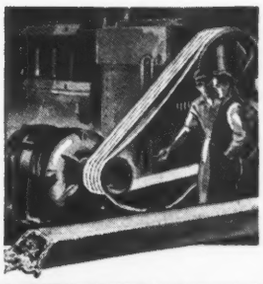
To get that efficiency, it's important that you know about Texrope Super-7 V-belts and what they can do for you. For here's a V-belt that is completely NEW . . . a V-belt that is literally *4 ways better!*

As a war-busy production man, you'll like Super-7's extra-strength construction . . . with 50% stronger cords, 20% more cords. You'll find the new rubber cushion section not only helps absorb the shocks of heavy wartime operation, but keeps the belt cool even under continuous, 24-hour-a-day requirements. You'll like the duplex-sealed cover for extra-protection . . . the true V-shape for maximum groove-grip action . . . the "matching" in sets for even pull, even wear.

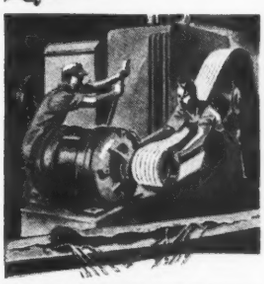
For smooth, silent, slipless, longer-wearing, top-notch performance . . . use Texrope Super-7 V-belts!

The full story of these new belts can be obtained from your Texrope dealer or your nearby Allis-Chalmers district office. Or you can write Allis-Chalmers, Milwaukee, Wisconsin.

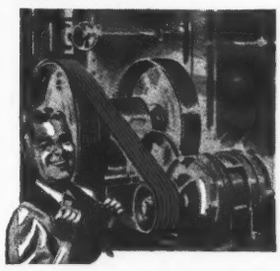
A 1486



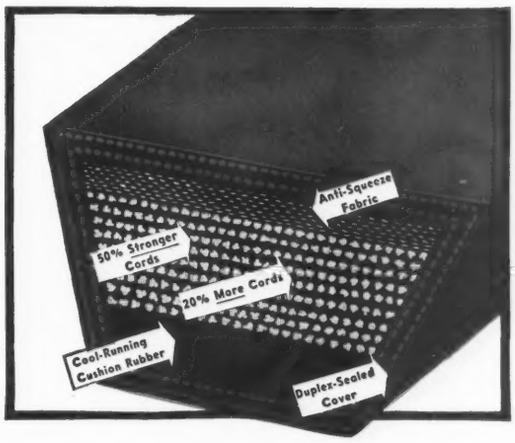
LOOK OUT FOR DANGER in belts with stiff, unpliable cords! Such belts *look* strong... but actually they buckle over sheaves, build up excessive heat that attacks pulling cords. Result: Belt failure far sooner than you expect it.



WARNING SIGN! Sagging, slipping belts mean too much stretch not backed up by balanced cord strength. Motor must be pulled back often to take up slack. Result: When stretch limit is reached belt breaks under tension.



SUPER-7 TEXROPE BELTS are made by amazing Flexon process that *combines* flexibility with low stretch... great strength. Cords float on cool-running, shock absorbing cushion rubber. Result: *true* strength . . . *true* pulling power . . . *true* endurance.



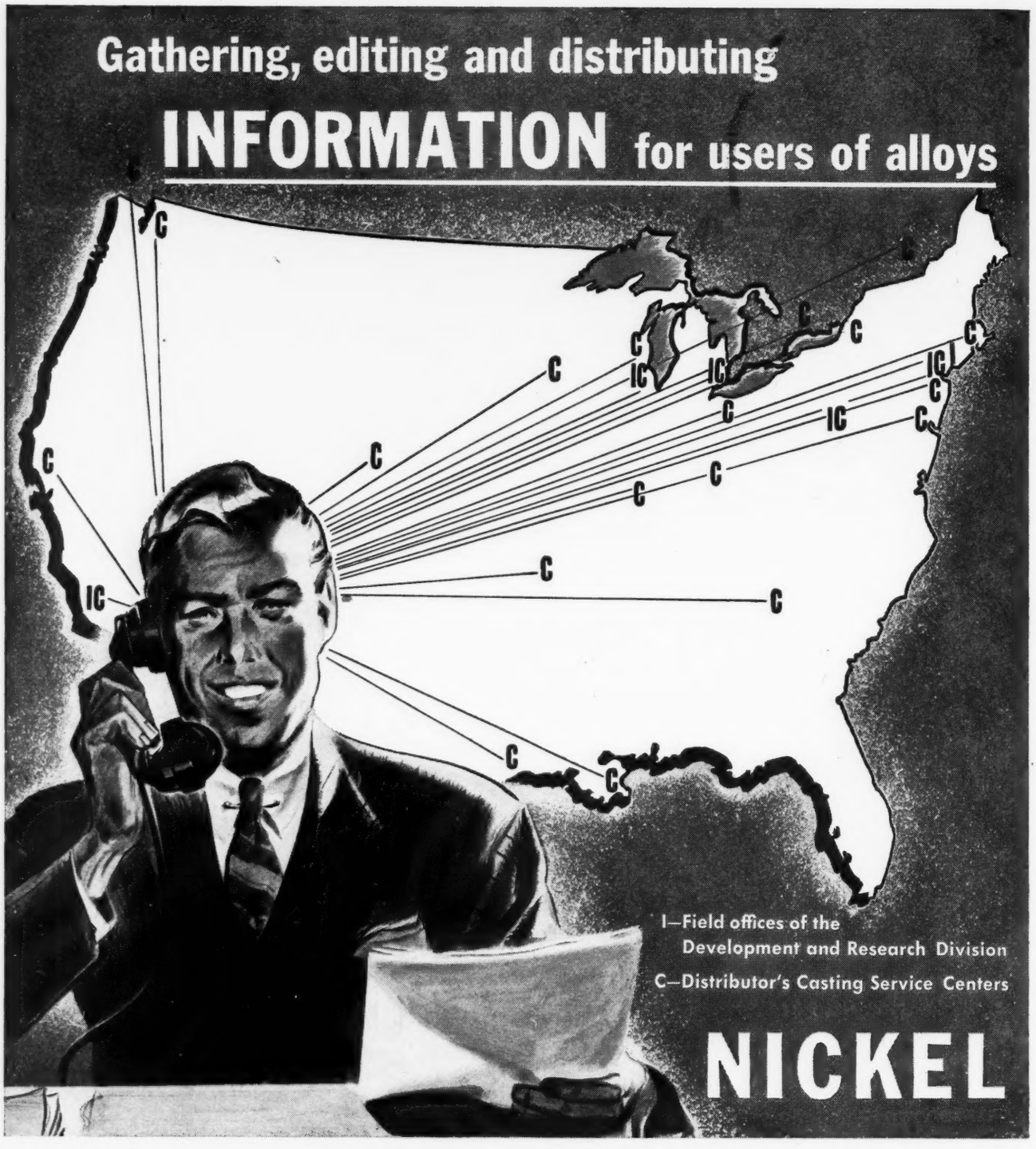
Available in All Sizes ½ hp to 2000 hp

*Trade mark registered U. S. Patent Office. Texrope Super-7 Belts are the result of the co-operative research and design genius of *two* great companies —Allis-Chalmers and B. F. Goodrich—and are sold exclusively by Allis-Chalmers.

ALLIS-CHALMERS

MILWAUKEE·WISCONSIN

Gathering, editing and distributing INFORMATION for users of alloys



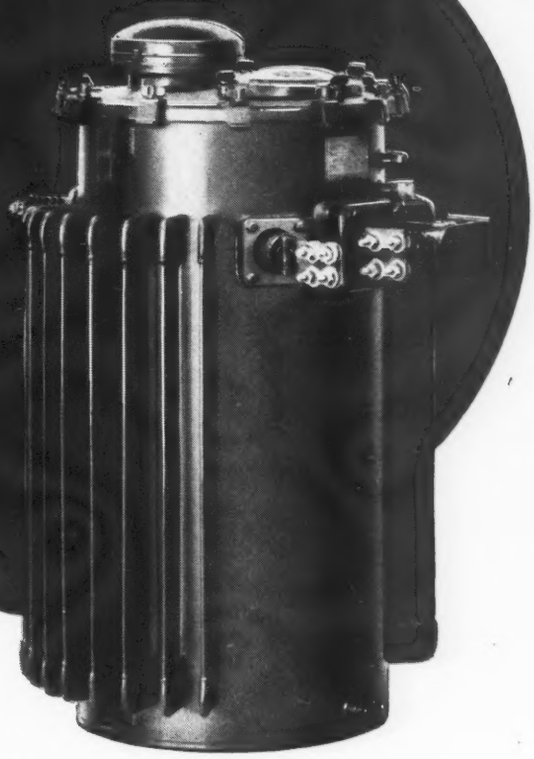
To aid users of Nickel alloys, thirty service centers are maintained in industrial areas. From these strategically located key points, our field representatives are on call to advise American industry about the selection, fabrication and uses of ferrous and non-ferrous materials. Assistance is also given on problems arising from the temporary lack of Nickel.

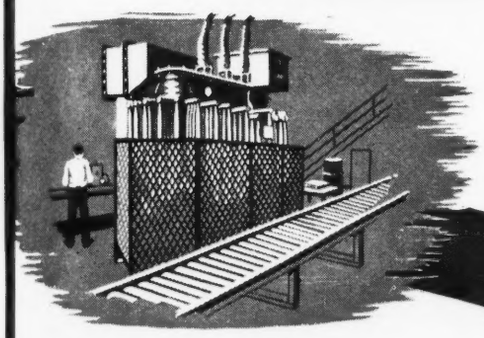
Through the years, research, field studies and user experience have all contributed to a fund of practical, time-proved information. Many of these data have been compiled in convenient printed form, useful both to experienced men handling new materials or performing unfamiliar operations . . . and to the many new employees.

Now . . . when minutes and materials are so vital . . . make full use of this metal-working experience. Send for a check list of helpful printed pieces on the selection, treatment, fabrication and use of Nickel alloys, or send your specific questions to:

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK, N. Y.

PYRANOL TRANSFORMERS

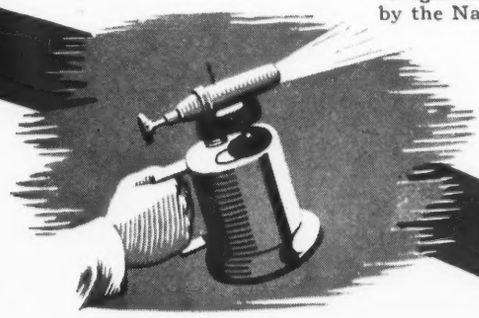




1 *Economical, speedy installation of transformers indoors* was made possible by the introduction of Pyranol* ten years ago. Today, hundreds of utilities, industrial plants, public buildings, and naval and military establishments use Pyranol transformers to supply power for vital production and other war activities.

*General Electric's noninflammable insulating and cooling liquid

2 *You can't burn Pyranol!* No Pyranol transformer has ever burned, or contributed to a fire! This record covers installations of more than 8,000 transformers, ranging in size from 1½ to 12,000 kva, and totaling more than 2,000,000 kva. It fully justifies the recognition given Pyranol transformers by the National Electrical Code.

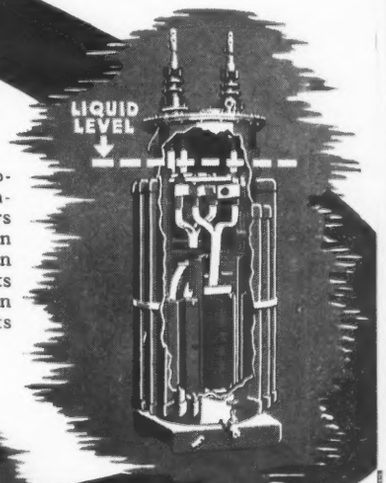


RIGHT now, safety and reliability of power supply are of paramount importance. Investigate the benefits of Pyranol transformers—especially indoor installations—when you need added transformer capacity. Compared with conventional outdoor installations, you'll make major savings—in time, construction materials, and in copper. Thousands in use prove it. Ask your G-E representative for complete information. Or, write for Bulletin GEA-2048C. *General Electric, Schenectady, N. Y.*

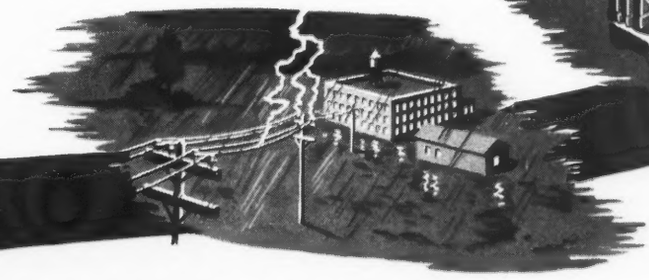
GENERAL ELECTRIC

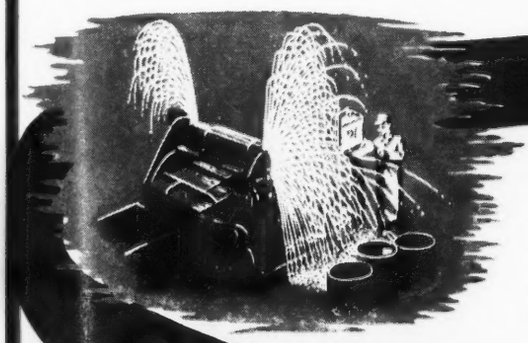
402-42-5100

General Electric and its employees are proud of the Navy award of Excellence made to its Erie Works for the manufacture of naval ordnance.



3 *The reliability of Pyranol transformers* is appreciated by users. It is based on design principles that have made liquid-filled transformers the most nearly trouble-free electric apparatus in service today. Heat-storage capacity—inherent in liquid-filled transformers—makes Pyranol units ideal for sustained emergency overloads. Immersion of the transformer interior in Pyranol prevents drying and cracking of the winding insulation.





5 *Little, if any, maintenance.* The sturdy tank, all-welded by electric process, protects vital parts of the transformer against sabotage and the entrance of moisture, dirt, dust. Pyranol is nonoxidizing, nonsludging. Years of use do not impair its insulating properties.

4 *High dielectric strength* both at normal frequency and impulse gives Pyranol transformers great ability to withstand voltage surges that originate from switching operations or lightning.

A BIG JOB of Water Softening

100,000 GALLONS PER HOUR COCHRANE DEAERATING HOT PROCESS SOFTENER AT PITTSBURGH PLATE GLASS COMPANY

AT THE BARBERTON, Ohio, plant of the Pittsburgh Plate Glass Company, is installed the largest deaerating hot process softener in the world—a Cochrane unit, of 100,000 gallons per hour capacity.

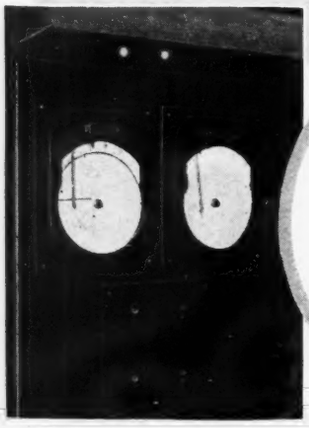
Heating and deaeration of raw and treated water are accomplished by external jet heaters and atomizers, while the condensate (18,000 GPH) is deaerated with a separate tray-type deaerator.

Lime and soda ash are used as reagents and are mixed in separate tanks, double-decked to conserve space. Reagents are proportioned to the sedimentation tank by means of proportioners electrically controlled by Cochrane Flow Meters.

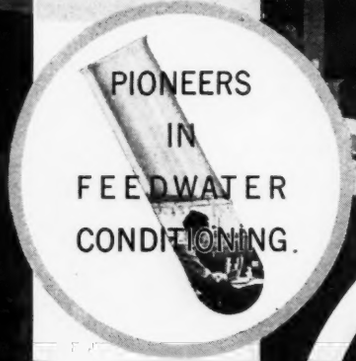
Like the chemical mixing tanks, the eight 11 ft. vertical filters are also double-decked as shown.

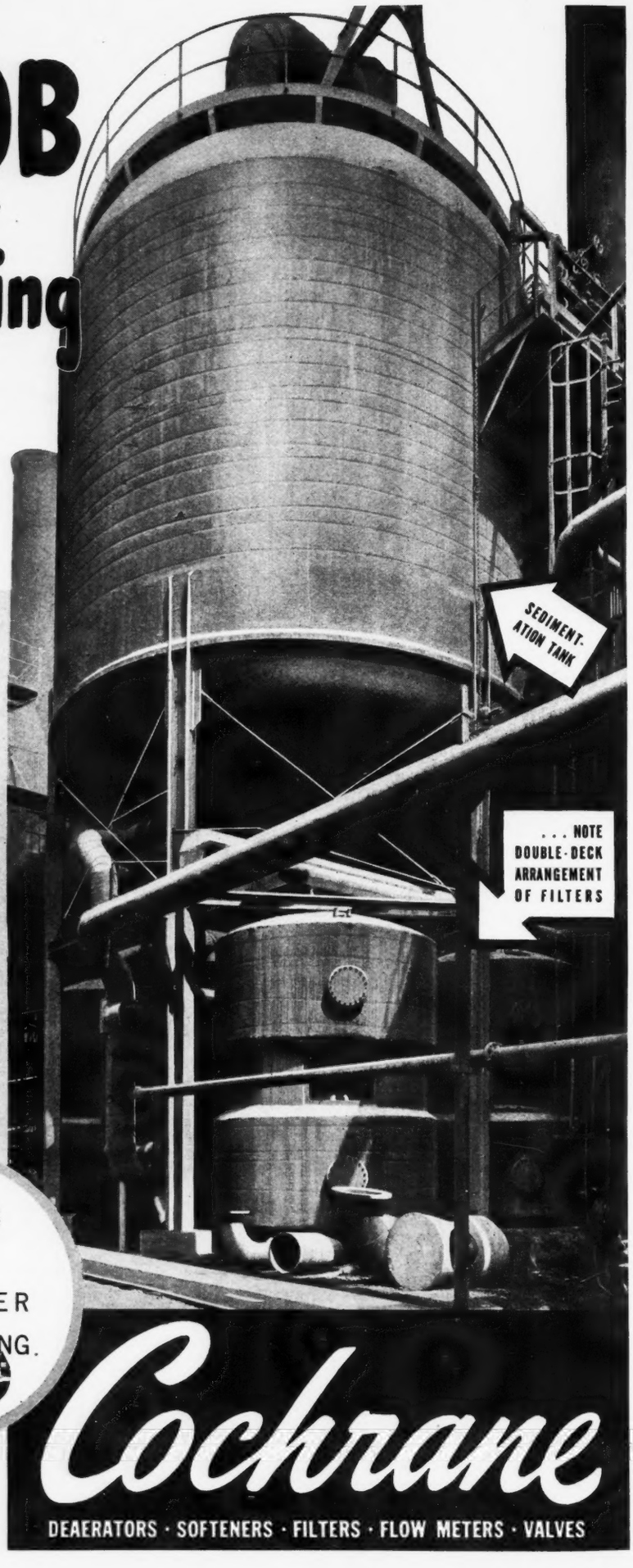
Interesting facts about modern water softening are contained in Cochrane Publication No. 3000. Write for a copy.

COCHRANE CORPORATION
3106 N. 17th Street • Philadelphia, Pa.



Cochrane Electric Flow Meters control proportioning of chemicals to sedimentation tank





Cochrane

DEAERATORS · SOFTENERS · FILTERS · FLOW METERS · VALVES

HOW YOU CAN GET

1. MORE SKILLED MAN-HOURS

2. GREATER PLANT OUTPUT

with Easy-to-Apply G-E TIMERS

FOR GREATER MACHINE OUTPUT

G-E timers relieve skilled operators of nonproductive clock-watching work. ● Make timing operations accurate and independent of operators' experience. ● Control speed of machines and conveyors to suit the skill of operators. ● Warm up furnaces and similar equipment before work, so operators can put in a full day.

FOR MORE SKILLED MAN-HOURS

G-E timers eliminate waste and spoilage caused by under- and overtiming. ● Keep motors on the line in spite of momentary power interruptions. ● Complete operations (such as heating and washing processes) after workers leave. ● Co-ordinate the operation of separate machines for continuous production.

TSA-10 INTERVAL TIMER

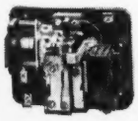
Telechron motor timed. Timing range from 0–5 seconds to 0–6 hours. Stepless variations of interval from 0% to 100% of maximum time. Voltage—115; 230 v. Frequency—25, 50, or 60 cycles. Circuit arrangement—single-pole, single-throw. Contact rating—1 amp at either 115 or 230 volts. Timer can be set externally or internally. Repeating operation requires another contact at zero. (Bulletin GEA-1771.)

TSA-14 CYCLIC TIMER

Telechron motor timed. Timing range from 10 seconds (total cycle) to 1 hour (total cycle). Continuously repeats a cycle of opening and closing contacts. Stepless operation from 1% to 99% of maximum time. Voltage—115 or 230 v. Frequency—25, 50, or 60 cycles. Circuit arrangement—single-pole, double-throw. Contact rating—10 amp at either 115 or 230 volts. Timer set internally. Repeats ON and OFF at selected time continuously. (Bulletin GEA-2963.)

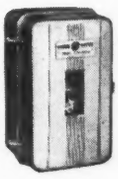
VACUUM-TUBE TIMER CR7504

Capacitor-timed, non-repeat-type timer. Six types give over-all timing range of 0.045 second to 120 seconds. Stepless operation from 5% to 100% of maximum time. Voltage—115, 230. Frequency—25 or 50/60 cycles; also for d-c operation. Circuit arrangement—single-pole, double-throw. Contact rating—1 amp at 115 v; 0.5 amp at 230 v. External time set. Requires two timers independently adjustable for repeating operation. (Bulletin GEA-2902.)



CR2820 TIME-DELAY RELAY

Telechron motor timed, interval type. Timing range from 4 seconds to 2 hours. Adjustment range from 10% to 100% of maximum time; steps approximate 5% of maximum time. Maximum voltage—600. Frequency—25, 50, or 60 cycles; also available for d-c operation. Circuit arrangement—single-pole, double-throw. Contact rating—15 amp at either 115 v or 230 v. Internal time setting. Requires two timers (independently adjustable) for repeating operation. (Bulletin GEA-2616.)



T-44 GENERAL-PURPOSE TIME SWITCH

Telechron motor timed. Opens and closes circuit at predetermined times. Astronomic dial for ON–OFF operation at dusk and dawn; skips ON operation for selected days. Minimum time interval—45 minutes. Maximum voltage—230. Frequency—25, 50, or 60 cycles. Circuit arrangement—single-pole, single-throw; single-pole, double-throw; double-pole, single throw; double-pole, double-throw. Contact rating—35 amp at either 115 v or 230 v. (Bulletin GEA-1427.)

General Electric and its employees are proud of the Navy award of Excellence made to its Erie Works for the manufacture of naval ordnance.

IS YOURS A SPECIAL PROBLEM?

Whenever you would like assistance with a special timing problem, the nearest G-E office will be glad to help.

SEND FOR FURTHER INFORMATION

General Electric, Sec. D676-58
Schenectady, N. Y.

I'd like more information about your timers. Please send me the bulletins checked:

☐ *GEA-1771* ☐ *GEA-2902* ☐ *GEA-1427*
☐ *GEA-2963* ☐ *GES-2616*

NAME.....

COMPANY.....

ADDRESS.....

CITY.....*STATE*.....

676-58-8606-3490

GENERAL ELECTRIC

"CALL TO SICK-BAY"

but not a man answered!

Wind screaming through the rigging! Dark, ominous storm clouds piling up in the northeast! And the captain bellowing, "Shorten sail . . . batten down all hatches!".

That was bad news for the bluejackets aboard early American warships. It meant berth decks sealed tight against ventilation—unbearably stuffy—damp, foul-smelling. A breeding place for disease. It meant a sick-bay crowded with stricken sailors.

But American skill and resourcefulness came up with the answer—a ventilating system for warships! The first mechanical ventilating system for warships, installed in 1879 on the famous U.S.S. Richmond, proved an immediate success. In the words of Chief Engineer King of the U. S. Navy, as quoted in the Army and Navy Journal of March 8, 1879: *"After consultation with Mr. B. F. Sturtevant, who has had large experience in ventilating buildings, a contract was made to design and build two exhausting fans."*

And, continues Chief Engineer King, in describing the results of this ventilating system: *"There is no smell of bilge water and no impure air on the berth deck. The officers and crew of this ship enjoy pure air at all times. It is the most healthful, completely ventilated ship that ever sailed under the American flag —or any other flag."*

Today, Sturtevant Ventilating and other Air Handling Equipment is still "In the Navy"... on a large majority of America's fighting ships, old and new—ships ranging from battleships to mine-sweepers—from aircraft carriers to sub-

Sturtevant

Puts Air to Work

for

War Production

Conserving Metal for Planes—During fabrication of sheet aluminum every ounce must be saved—and Sturtevant helps do it! Scrap aluminum is chopped up, then conveyed—entirely by air route—to remelt furnaces at Aluminum Company of America plants.

Toughening Steel for Tanks—To harden steel properly, heat treating furnaces require constant pressure, unfailing air circulation. Chrysler Tank, Caterpillar Tractor and others call on Sturtevant for compressors that help step up capacity—speed production.

marines! It is also supplying the vital blasts of air for thousands of processes and hundreds of industries that are building America's fighting machines.

B. F. STURTEVANT COMPANY

Hyde Park, Boston, Mass. *Branches in 40 Cities*

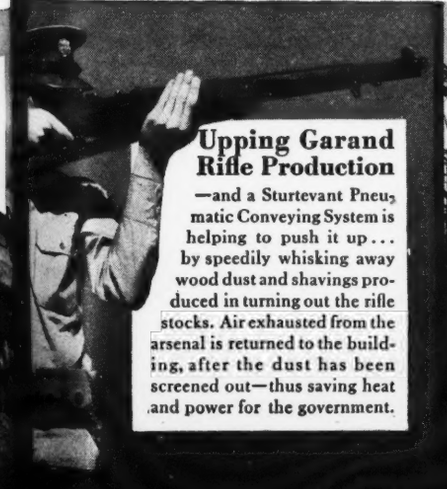
B. F. Sturtevant Company of Canada, Ltd., Galt, Toronto, Montreal

Sturtevant

REG. U. S. PAT. OFF

Puts Air to Work

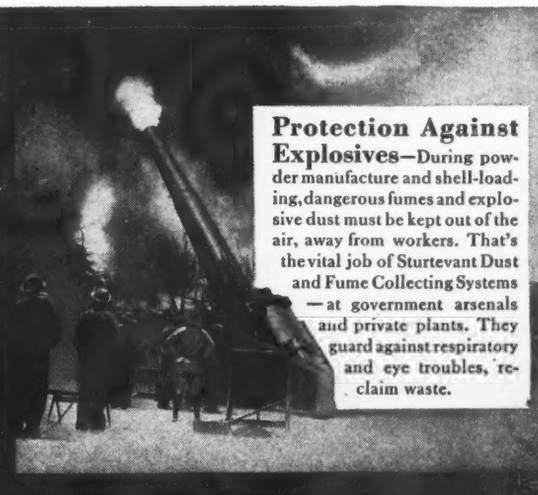
STURTEVANT — FOUNDER OF THE AIR HANDLING INDUSTRY



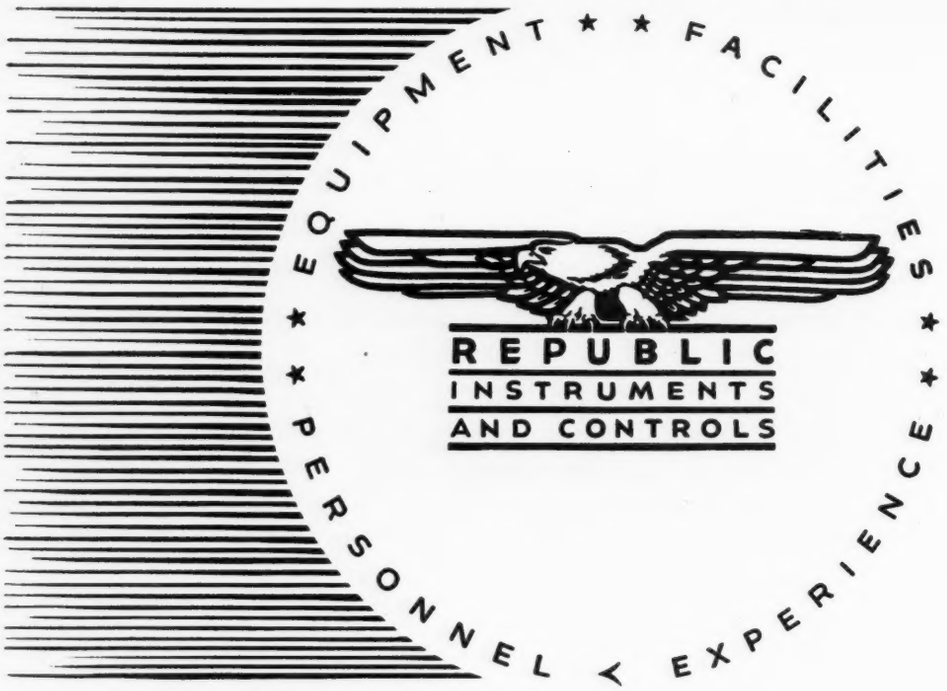
Upping Garand Rifle Production

—and a Sturtevant Pneumatic Conveying System is helping to push it up... by speedily whisking away wood dust and shavings produced in turning out the rifle stocks. Air exhausted from the arsenal is returned to the building, after the dust has been screened out—thus saving heat and power for the government.

Helping launch more Ships—For high speed Unionmelt Automatic Electric Welding of ships and boilers, at shipyards, Sturtevant Melt Recovery Units make it possible to efficiently collect all of the unfused melt for re-use.



Protection Against Explosives—During powder manufacture and shell-loading, dangerous fumes and explosive dust must be kept out of the air, away from workers. That's the vital job of Sturtevant Dust and Fume Collecting Systems—at government arsenals and private plants. They guard against respiratory and eye troubles, reclaim waste.



THE PROBLEM OF Stretching Capacity OF EXISTING BOILER EQUIPMENT

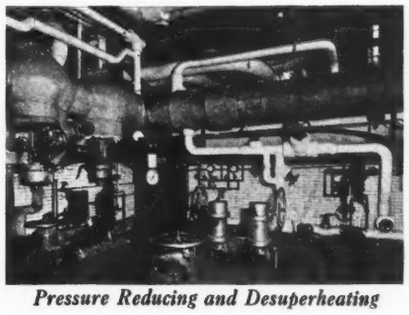
★

To the power engineer, industry's call for top-speed production is a call for more steam . . . a call which, in many plants, must be met by "stretching" existing generating capacity through shrewd operation, since new steam generating units are not immediately available.

The problem of "stretching" present capacity involves the acquisition of complete knowledge of existing conditions, so that losses in steam generation and distribution may be eliminated and optimum operating efficiency maintained. The correct solution depends on two fundamental procedures.

First, the existing conditions must be determined by use of proper instruments. Second, the optimum conditions must be determined and maintained by the use of instruments and by proper methods of control.

Republic offers a complete line of power plant instruments and controls designed and built to meet today's power plant requirements. We will be glad to cooperate with you in the solution of any steam generation or distribution problem you may have.

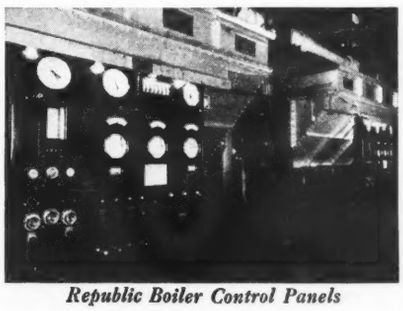


Pressure Reducing and Desuperheating

★

AUTOMATIC COMBUSTION CONTROL

Republic-Smoot automatic combustion control systems are built for all sizes of boilers — all types of fuel firing equipment — all load conditions — any arrangement of draft equipment.



Republic Boiler Control Panels

★

POWER PLANT INSTRUMENTS

Flow meters, draft instruments, CO_2 meters, thermometers — a complete line of power plant instruments, designed and built by Republic, for analyzing and checking plant performance.

★

BOILER WATER LEVEL CONTROL

The Republic-Smoot boiler water level control system is designed to maintain boiler drum water level within ± 1 inch of the desired level when the boiler is operating under normal conditions.

★

REGULATING VALVES

Republic-Smoot turbine type valves are designed for regulating pressure and flow of high-pressure superheated steam or boiler feedwater. They are built for tough jobs in which the valve occupies a key position in the operation of a system or an entire plant.

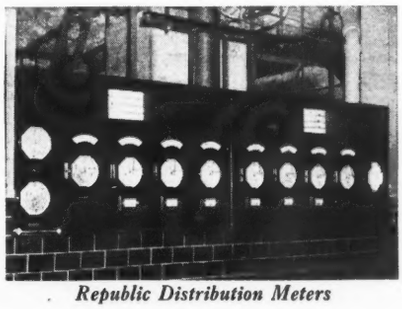
★

DESUPERHEATERS

For control of steam temperatures in interconnected systems, several types of Republic-Smoot desuperheaters are available to meet special operating requirements.

★

Whether your particular problem involves the use of a single instrument or the control of an entire process or plant, Republic engineers will be glad to study your problem and, in co-operation with your own engineers, make recommendations as to the most practical solution.



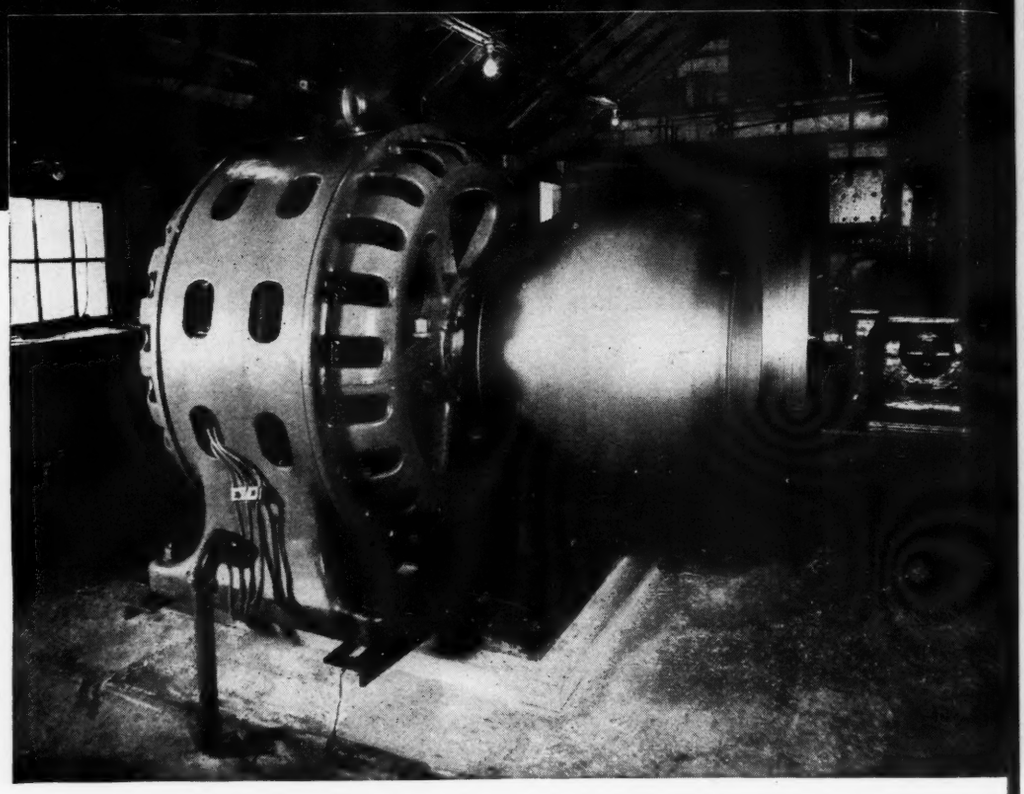
Republic Distribution Meters

Your request for our co-operation in solving your power plant problems will involve no obligation on your part. Write us today.

Republic Flow Meters Co.

2222 Diversey Parkway • Chicago, Illinois

AMERICAN



Econ-O-Matic Drives Mean Automatic Economy

American Econ-O-Matic* Flat-Belt Drive

Lengthens Belt Life, Cuts Power Costs at Coeur d'Alene Mine!

At the Coeur d'Alene Mines Corporation, Wallace, Idaho, producers of silver, lead and zinc essential to the war effort, a large air compressor drive was giving trouble.

Problem: The compressor drive operated with a gravity tightner pulley. The 27" leather flat-belt on this drive was pulling against the tightner under constant tension. Because of this severe service, the belt had developed a bad "burn" and was about to be scrapped.

Solution: An **American Econ-O-Matic Flat-Belt Drive** was installed, incorporating the unique American Motor Base that gives automatic tension control. As a result, the idler or tightner pulley was eliminated. Also, the "American" representative removed the belt burn while shortening the belt to take up the slack resulting from elimination of the tightner.

Results: The original leather belt was not only saved—it is expected to give years of trouble-free service! *Power consumption* has been *reduced*. *Compressor efficiency* has been *increased*. These benefits have been achieved because:

1. Belt slip is eliminated.
2. Belt wear is reduced...no reverse bend under tightner.
3. Original center distance has been retained, but the belt travels a shorter distance and operates more efficiently since the tightner pulley has been removed.
4. Bearing life is lengthened, because there is no jerking on the bearings from the tightner pulley.
5. Maintenance costs less and requires fewer man-hours . . . with *automatic* tension control replacing manual adjustments.

What You Can Expect from American Econ-O-Matic Drives

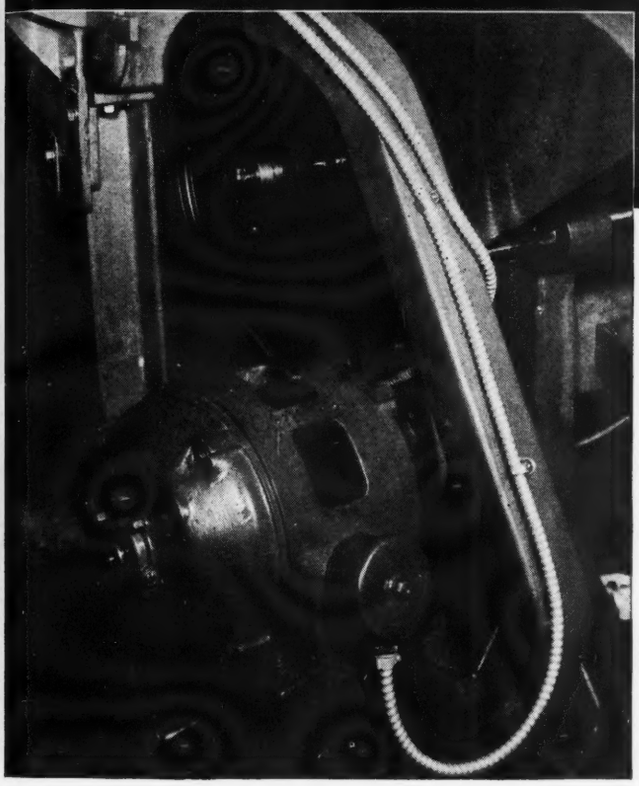
- ★ Increased production because correct RPM level is sustained . . . no belt slip.
- ★ Low first cost quickly saved in reduced power consumption.
- ★ Man-hours and materials required for maintenance reduced up to 75%.
- ★ Bearing pressure reduced by 50%.
- ★ Belt life increased by an average of 100%.

Let our engineers prove these economies to you!

THE American

4242 WISSAHICKON AVENUE

ECON-O-MATIC* DRIVES



AMERICAN Drive Selection Service

HOW ABOUT IT?

Want the quickest and most efficient answer to your Short-Center Drive Problems? Call for AMERICAN DRIVE SELECTION SERVICE. Our engineers and distributors are installing both Flat-Belt and V-Belt Drives every day in the year. They can give you impartial advice on the type best suited to each operating condition in your plant. Write us about your problems *today!*

American Econ-O-Matic* V-Belt Drives

Improve Knitting of Fabrics and Cut Electrical Equipment Costs!

Alfred Hofmann & Company, West New York, N. J., maker of "Simplex" machines for knitting glove fabrics and rayon cloth, needed a drive to meet special conditions.

Problems: 1. The "Simplex" machine requires a drive that can be varied slightly in speed—only enough to compensate for an occasional change in the material being knitted.

2. The drive should come up to full speed quickly and then hold this speed without fluctuations. Fluctuations in machine speed *during* a production run cause visible flaws in the knitted fabric.

Solution: An American Econ-O-Matic V-Belt Drive for each knitting machine. This drive includes the American Motor Base for automatic tension control, and thus sustained speed without belt slip. Also, the drive incorporates American Adjustable-Diameter Wedgbelt Pulleys, which permit occasional speed changes, *between* production runs on different fabrics.

This American Econ-O-Matic V-Belt Drive operated by an induction motor replaces a rotor-wound motor with resistor controls to achieve speed variations. This previous system needed manual control, started unevenly, and then did not maintain speed, since the motor became hot and built up resistance.

Results: With American Econ-O-Matic V-Belt Drives

1. Knitted fabrics are produced more uniformly . . . machines now operate at constant speed.
2. A variety of fabrics can be knitted on the same machine, by simply adjusting diameters of the Wedgbelt Pulleys *before* any given production run.
3. Savings of at least 50% have been achieved in the cost of electrical equipment for each knitting machine.

Pulley COMPANY
PHILADELPHIA, PA.

E
Navy "E" for excellence awarded February 12, 1942

***Econ-O-Matic Drives** are short-center drives, either flat-belt or V-belt, with American Motor Bases for automatic tension control—and thus *automatic economy.*

IRON FIREMAN P·S· STOKER (PNEUMATIC SPREADER) Tops the

P·S· Superiority is Demonstrated by this Typical Installation

Evaporation per Pound of Coal Increased 16%* in South Carolina Plant

(By Jack Fanning, Condensed from "Southern Power and Industry")

AN interesting boiler reconditioning job, resulting in annual savings of $11,800, was completed in 1940 in the steam plant of the Hartsville Print & Dye Works, located at Hartsville, S.C. The plant has been in operation long enough to allow cost comparisons.

It was found necessary, due to additional steam operated equipment being installed in the factory, to increase steam capacity. A survey was made at that time, including evaporation tests to determine steam capacity and requirements. From the result of these tests, recommendations were submitted to equip the 525 h.p. Babcock & Wilcox boiler for pneumatic spreader stoker firing.

JACK WEST
Master Mechanic, Hartsville Print & Dye Works.

The installation proved satisfactory from both an operating and an efficiency standpoint. The plant now shows an average over-all efficiency of 76.5% with the boiler operating at an average of 162% rating, including two or three hour peaks of operation at from 200% to 225% rating. (Former over-all efficiency was 66%.)

The equipment has proved that it is capable of burning any of the coal available in the area, regardless of ash content or fusion point of ash.

Since the boiler was reconditioned and placed in operation last September, the fuel cost per thousand pounds of steam has been reduced 21½%. *Studies show that the total investment involved is liquidated in 12 months' time.**

Tests before and after improvements to the 525 h.p. boiler indicate that the old performance gave only 9½ lb. evaporation per lb. of coal; whereas, now the evaporation is raised to 11.09 lbs. of water per lb. of coal—an increase of 16%.

**This represents an earning on the investment in Iron Fireman P. S. Stokers of 100% a year.*

IRON FIREMAN
THE IRON FIREMAN
Automatic Coal Stokers

Field these 5 Ways:

No other stoker in the world brings you all these advantages of the Iron Fireman Pneumatic Spreader.

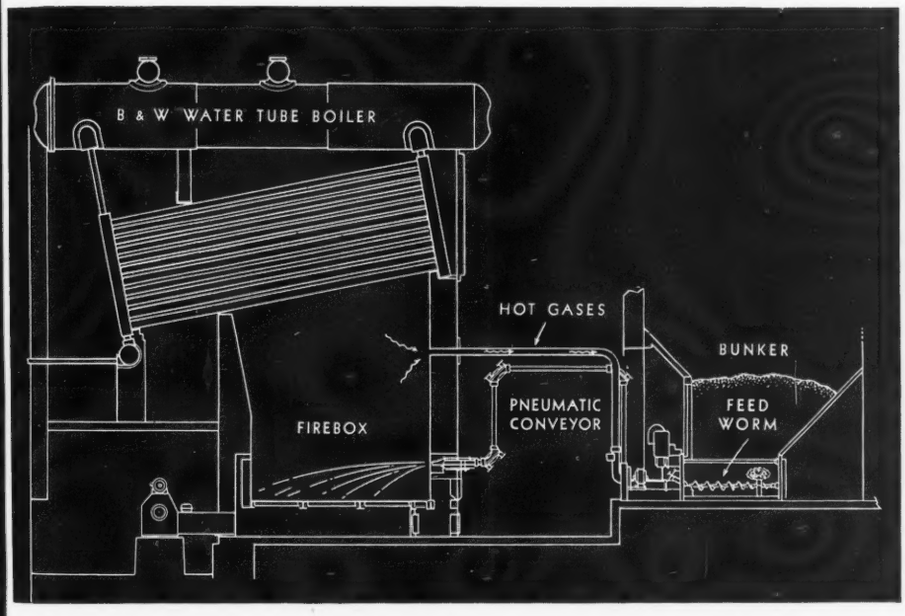
1 **Fuel Economy.** Burns efficiently such economical fuels as the lower grade bituminous coals and also sub-bituminous and lignite coals. Coal is conveyed and distributed on a stream of air or hot gases. The fines burn in suspension, utilizing the conveying air for combustion. The larger pieces form a shallow fuel bed on the grate.

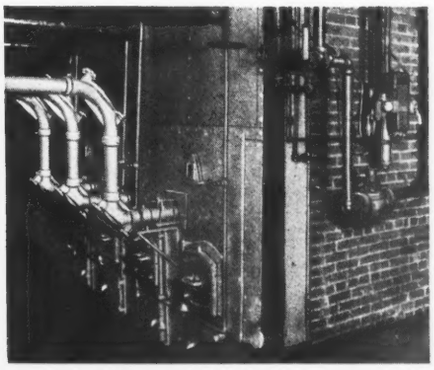
2 **Flexibility of Installation.** The stoker can be located anywhere within a reasonable distance of the boiler front —either above, below, or on the same floor as the boiler.

3 **Ease of Operation.** Coal is automatically fed either from a large-capacity hopper or directly from the bunker.

4 **Low Maintenance.** No moving parts are exposed to fire-zone. Grate design provides ample coaling. Lubrication system is positive and efficient. Users' records show very low costs per ton of coal fired.

5 **Reliability.** The Pneumatic Spreader stoker was pioneered and developed by Iron Fireman, the world's largest builder of automatic coal firing equipment. It is ruggedly built, of the finest materials, to precision standards.

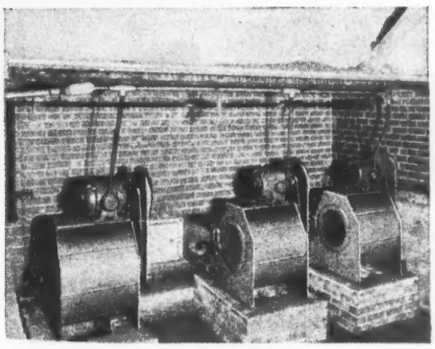




Front of boiler, showing the coal-conveyor tubes, clean-out doors, and controls. The boiler can readily be hand-fired in case of power failure.

P. S. Installation in Hartsville, S. C. Print and Dye Works

The conveying worms of the three Iron Fireman Pneumatic Spreader stokers are installed through the front wall of the coal bunker. The conveying mechanism is located 12 feet from the boiler front, and coal is unloaded from cars directly into the bunker. The worms carry the coal from the bunker to the transfer housings, where hot furnace gases at high-velocity pick up the coal and convey it through pipes to nozzles, which distribute it uniformly to the fire-bed. The units are so arranged that the three nozzles may be operated simultaneously or separately, according to steam requirements. Both coal and air are automatically controlled —the requirements being set by the demand for steam. Very little attention is required, other than periodically cleaning the fires.



Three low-pressure forced draft fans are located in the rear of the boiler with ducts under the floor of the last pass. Each fan furnishes air to a separate section of the grate. This arrangement permits cleaning one section of the grate at a time. Cleaning is done easily and without loss of pressure.

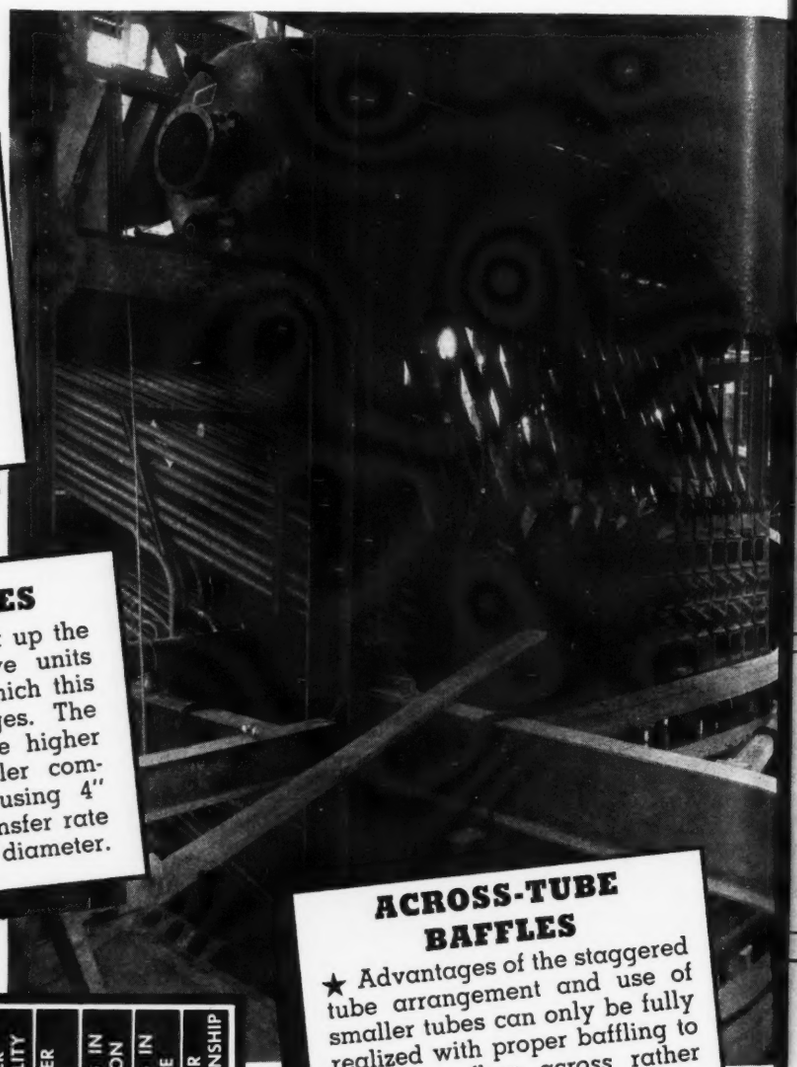
FREE BOOK on Pneumatic Spreader Firing

Contains full descriptions, capacities, operating data, etc., with layouts and photos of 10 actual installations. Sent free, on request. Write to Iron Fireman Mfg. Co., 3304 W. 106th Street, Cleveland, Ohio.

FEATURES THAT MEAN

SPRINGFIELD BOILERS

Erection pictures and cross-section drawing of one of the three new 80,000 lb. Springfield units at University of Illinois, Champaign, Ill. CONSULTING ENGINEERS: Sargent & Lundy.



EXCLUSIVE STAGGERED TUBE ARRANGEMENT

★ Losses caused by stratification and blow-thru of hot gases upward along straight vertical or diagonal lines are minimized by Springfield's distinctive, staggered 4-tube grouping which effectively breaks up the gas stream insuring good heat transfer.

USE OF SMALLER TUBES

★ Springfield uses 3" tubes to break up the water into smaller, more responsive units which accounts for the ease with which this boiler responds to rapid load changes. The smaller tubes also contribute to the higher efficiencies obtained with this boiler compared with competitive designs using 4" tubes, since the convection heat transfer rate is an inverse function of the tube diameter.

ACROSS-TUBE BAFFLES

★ Advantages of the staggered tube arrangement and use of smaller tubes can only be fully realized with proper baffling to force gas flow across rather than parallel with the tubes. Springfield uses sectional baffles designed to form an exceptionally tight and permanent across-tube baffle wall and arranged to force direct impingement of gases against tube surfaces — a feature that regularly accounts for lower exit gas temperature.

"PLUS VALUES" OFFERED BY SPRINGFIELD:	HIGHER EFFICIENCY	LOWER MAINTENANCE	HIGHER RELIABILITY	LONGER LIFE	SAVING IN ERECTION	SAVING IN SPACE	BETTER WORKMANSHIP
3" DIAMETER BOILER TUBES	✓						
STAGGERED 4-TUBE GROUPING	✓	✓			✓	✓	✓
ELECTRIC FURNACE STEEL HEADERS		✓	✓	✓	✓		✓
SECTIONAL 1-PIECE BAFFLES	✓	✓	✓	✓	✓		✓
CLOSE SPACING WATER WALLS	✓	✓	✓	✓			

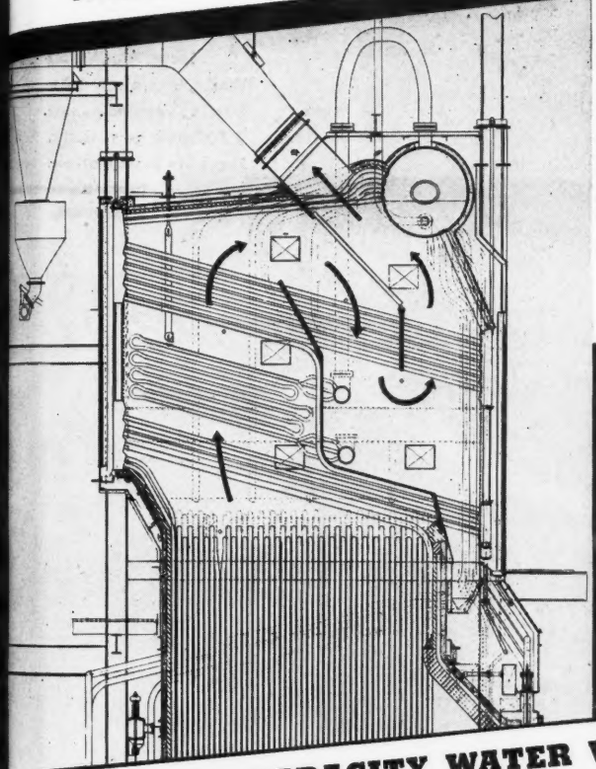
SPRINGFIELD

MODERN STEAM GENERATING UNITS

BETTER PERFORMANCE

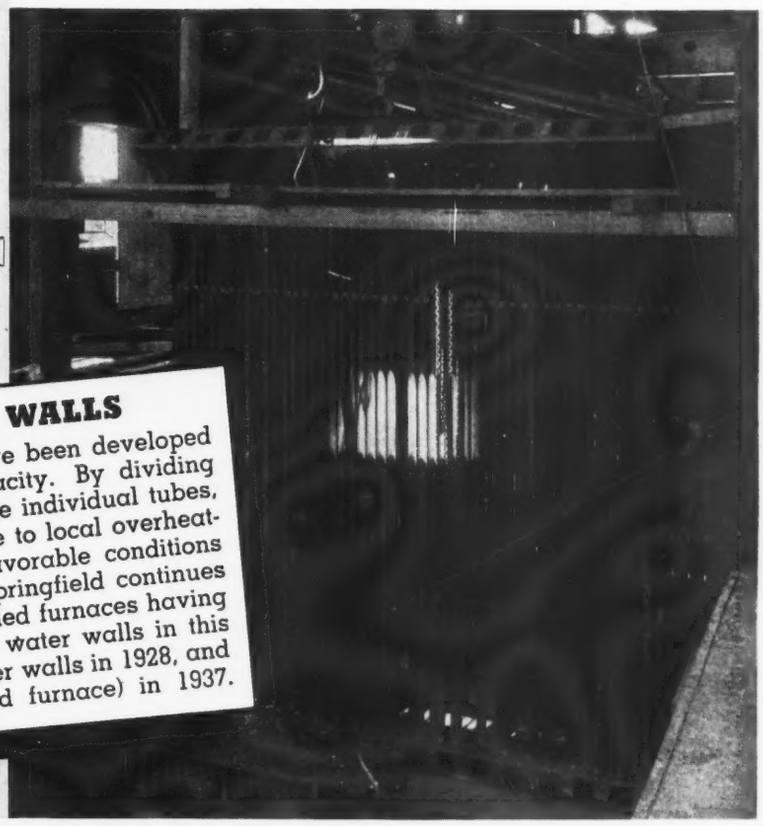
SINGLE DRUM: EASY WATER LEVEL CONTROL, DRY STEAM

★ There is no variable steam space ahead of the steam drum in a Springfield boiler. As a result, there is none of the annoying shifting of water volume that can cause carry-over and other serious trouble under sudden load changes. Springfield's reputation as a dry "steamer" is backed by numerous independent records.



FEATURES found only in Springfield boilers are largely responsible for the extra dividends they pay in lowered operating costs and increased service hours. The "Springfield Design" is not just another way of arranging tubes, drums, baffles, etc. Rather, it is the utilization of certain fundamental principles in design to secure specific benefits.

At the present time, organizations engaged in defense work, or otherwise able to obtain priority ratings, can get quicker delivery — save money — and aid in conserving metals on steam plant requirements by taking advantage of the distinctive construction features of Springfield straight tube, cross drum, sectional header boilers. Complete drawings, patterns, shop fixtures, etc., are on hand to duplicate any of the many modern Springfield steam generating units built in recent years. Capacities from 5000 lbs. to 450,000 lbs. per hour, or more. Pressures from 75 lbs. to 750 lbs., or higher. Springfield regularly takes contracts for complete steam generating units. Write, phone, or wire for quotations. SPRINGFIELD BOILER CO., 1953 E. Capitol Ave., Springfield, Illinois.



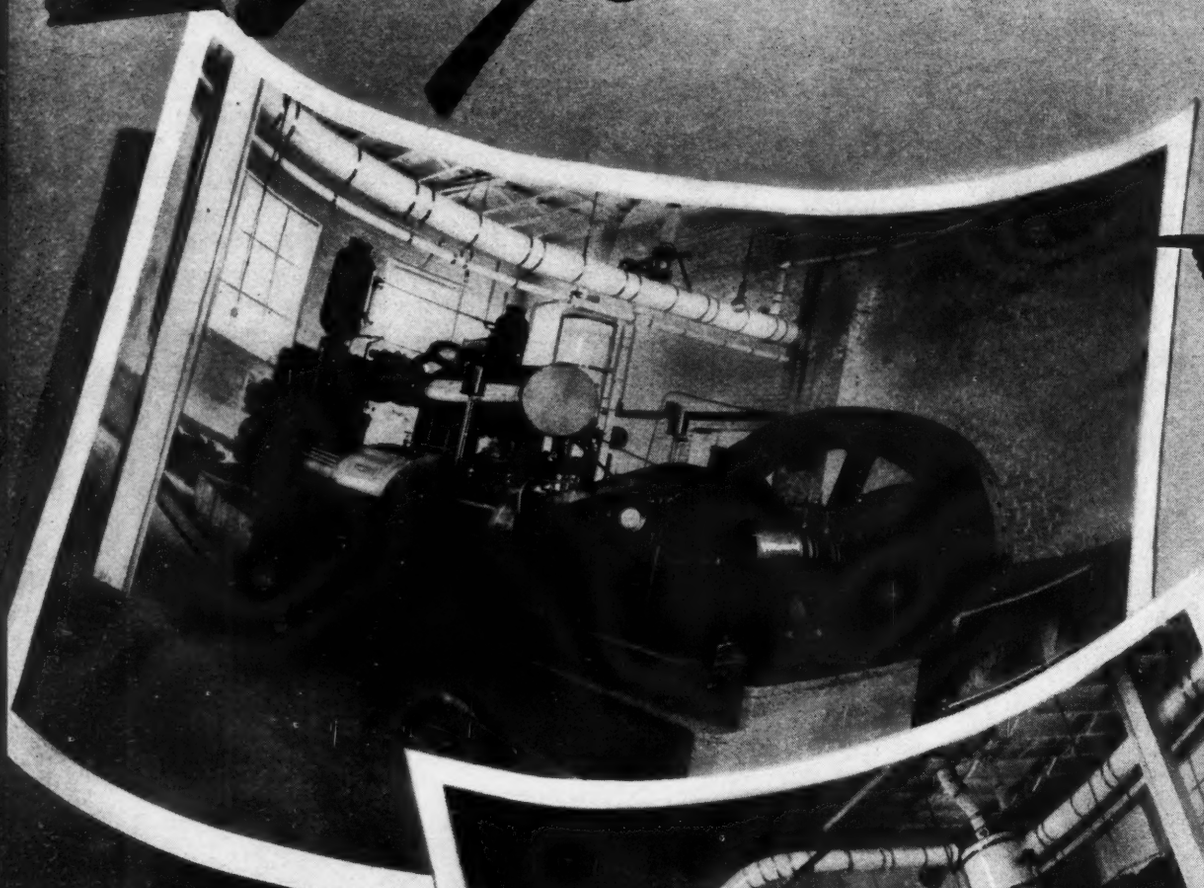
HIGH CAPACITY WATER WALLS

★ Springfield close-spaced water walls have been developed to provide the maximum in overload capacity. By dividing the work and reducing steaming rates in the individual tubes, the whole installation is made less sensitive to local overheating, bad water conditions, and other unfavorable conditions which may occur in average operation. Springfield continues to pioneer in the development of water cooled furnaces having installed the first commercially successful water walls in this country in 1923, the first close spacing water walls in 1928, and the first large center water wall (divided furnace) in 1937.

BOILER CO.

ANY SIZE • ANY FUEL • ANY PRESSURE

27 years old...



In the 27 years that have elapsed since 1915, cylinders have never been opened. "Original rings are still steam-tight," says C. S. Read, Supt. of the Tuscaloosa, Ala., Water Works, where this 14 x 30 x 10¼ engine pumps 2,700,000 gals. daily. Since its installation, lubricants have been Texaco 100%.

After 16 years, inspection of this 17 x 32½ x 11 Corliss finds tool marks still visible on cylinder walls, rings in perfect condition. It, too, has been 100% Texaco since the start.

TEXACO

TEXACO

Original Rigs

FULL POWER
TOP STEAM ECONOMY

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Hundreds of engines like the two shown are giving maximum power per pound of steam, even after long years of service, because they are lubricated with *Texaco Steam Cylinder Oils.*

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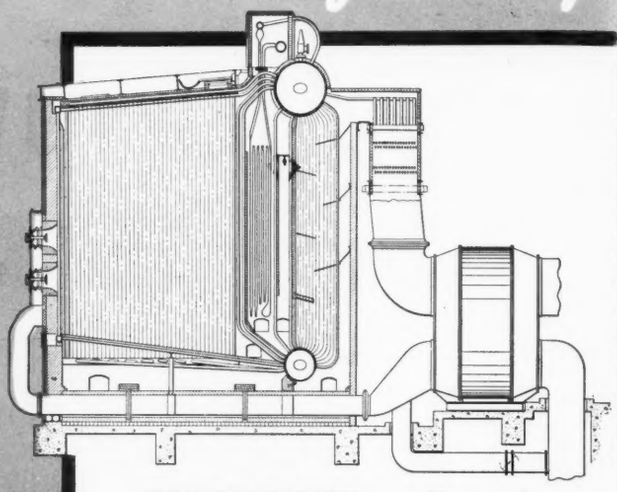
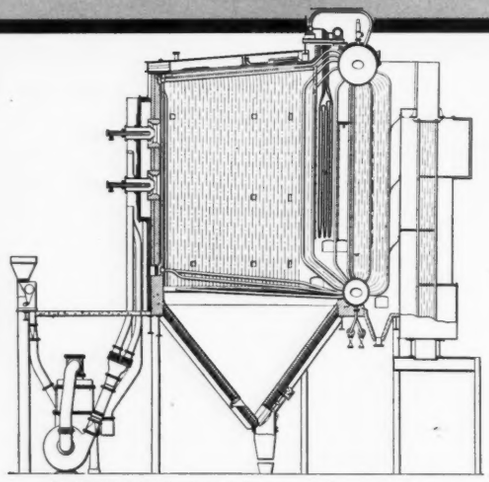


300,000 lb VU Steam Generator
oil-fired

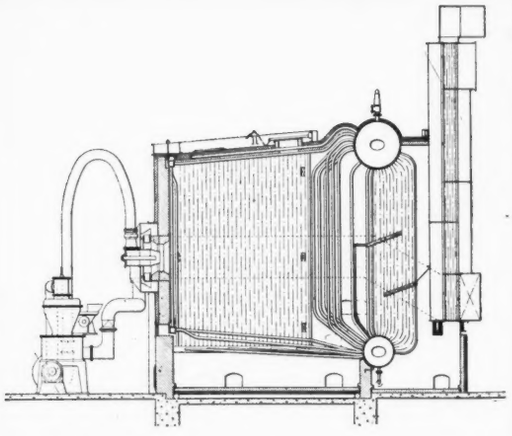
A semi-outdoor installation for a large southern public utility. Includes an Elesco Interbank Superheater and an Elesco Fin Tube Economizer. Design pressure—1000 psi. Total steam temp.—905 F.

Pulverized Coal, Oil, Gas Firing



150,000 lb VU Steam Generator
pulverized coal or natural gas-fired

Installation of a mid-west transportation company. Includes Elesco Superheater and Tubular Air Heater. Firing equipment consists of C-E Raymond Bowl Mills and C-E Type R Burners. Design pressure—475 psi. Total steam temp.—735 F.



60,000 lb VU Steam Generator
pulverized coal or oil-fired

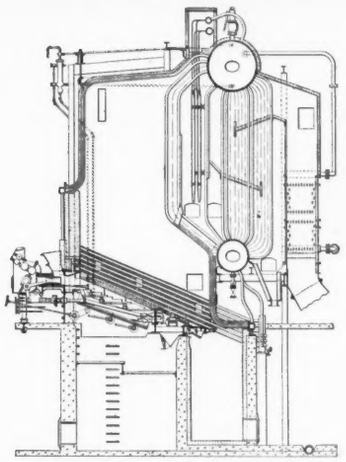
Installation of a southern textile mill. Firing equipment consists of C-E Raymond Bowl Mill and C-E Type R Burner. Design pressure—300 psi. No superheat.

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS, AND AIR HEATERS

COMBUSTION

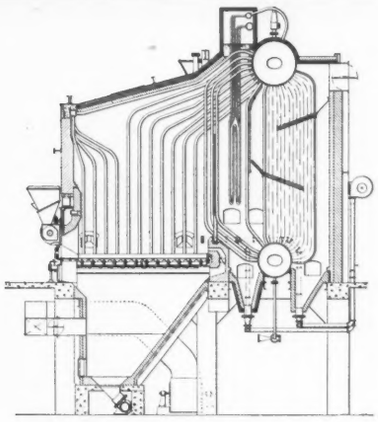
VU-Z STEAM GENERATORS

fuel or method of firing



70,000 lb VU-Z Steam Generator with C-E Multiple Retort Stoker

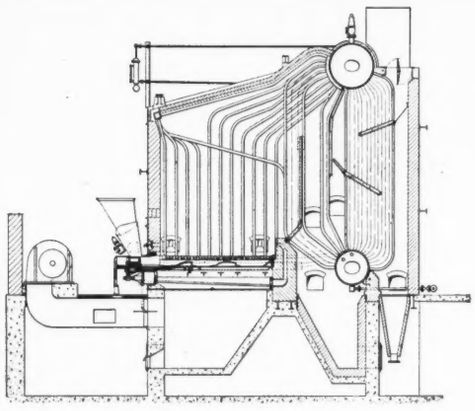
Installation of a large southern utility. Includes Elesco Interbank Superheater and Elesco Fin Tube Economizer. Design press.—250 psi. Total steam temp.—510 F.



38,800 lb VU-Z Steam Generator with C-E Spreader Stoker

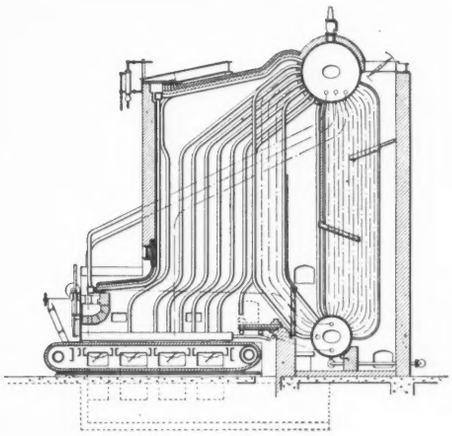
One of three VU-Z Units installed by a mid-west cement plant. Included are Elesco Interbank Superheaters. All three are fired by C-E Spreader Stokers. Design pressure—275 psi. Total steam temp.—468 F.

Various Types of Stoker Firing



35,000 lb VU-Z Steam Generator with C-E Type E Stoker

Installation of an eastern oil equipment manufacturer. Design pressure—200 psi. No superheat.



35,000 lb VU-Z Steam Generator with C-E Chain Grate Stoker

Installation for a mid-west confectionary plant Design pressure—200 psi. No superheat.

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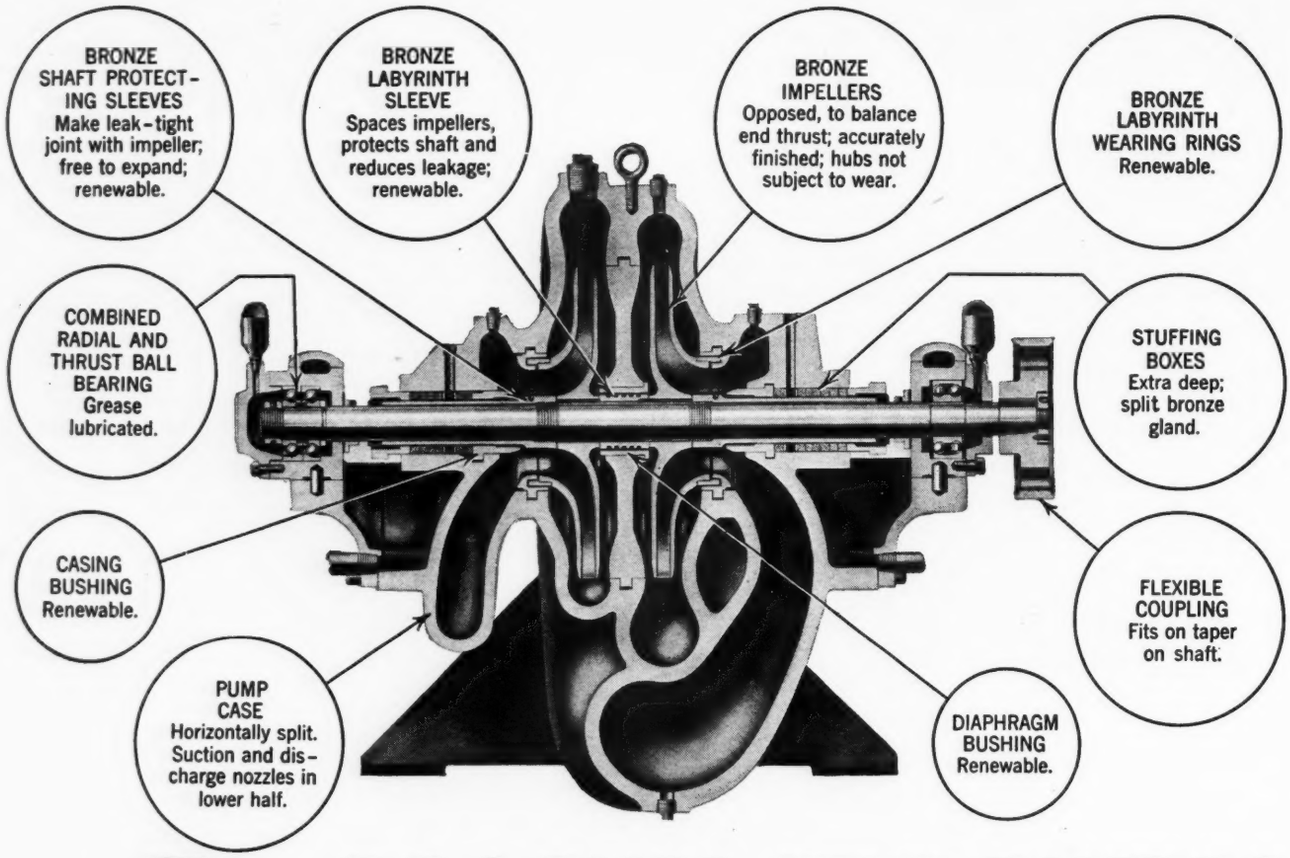
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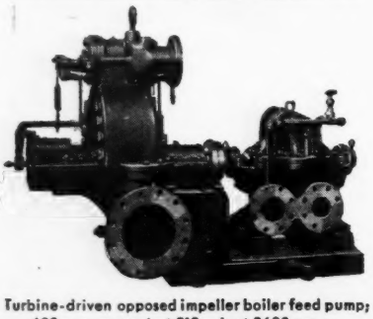
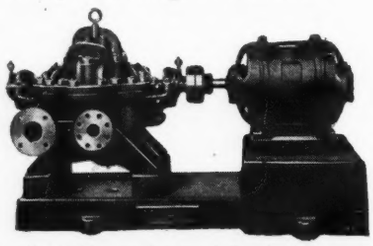
Ask for Catalog B-3-3624



Turbine-driven opposed impeller boiler feed pump; 600 g. p. m. against 310 psi. at 3600 r. p. m.



Motor-driven series-type boiler feed pump; 100 g. p. m. of 210° F. water against 165 psi. at 3500 r. p. m.

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N O WYNKOOP, *Publisher* PHILIP W SWAIN, *Editor*
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Publication office: 99-129 North Broadway, Albany, N. Y.
Editorial & Executive Offices: 330 West 42nd St., New York, N. Y.

CHICAGO, 520 North Michigan Ave.
SAN FRANCISCO, 68 Post St.
WASHINGTON, National Press Bldg.
PHILADELPHIA, 16 South Broad St.
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LONDON, Aldwych House, Aldwych, London, W C.2

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POWER articles are currently indexed in both the Industrial Arts and the Engineering Indexes, available at public libraries. Also every year POWER issues an annual index of its own. Cable Address: "McGraw-Hill, N. Y."

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FROM 5 HP UP

SPUN TENONS SECURE THE SHROUDS

Round, spun tenons at the blade ends secure shrouding, which stiffens blades against vibration, and confines steam to the blade path. Result: a uniform shroud fastening, without setting up of stresses in the blades.

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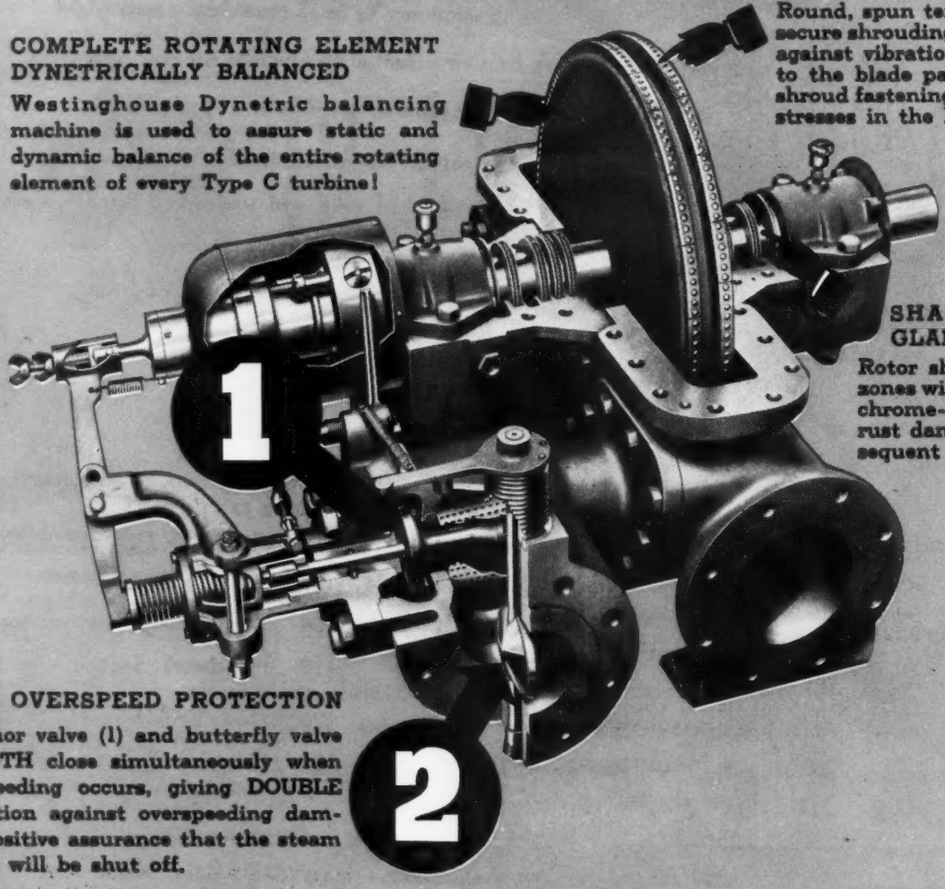
Westinghouse Dynetric balancing machine is used to assure static and dynamic balance of the entire rotating element of every Type C turbine!



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Rotor shaft is protected at the gland zones with a sprayed-on surface of high chrome-nickel steel alloy. This prevents rust damage to carbon rings and consequent steam leakage.

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Governor valve (1) and butterfly valve (2) BOTH close simultaneously when overspeeding occurs, giving DOUBLE protection against overspeeding damage, positive assurance that the steam supply will be shut off.

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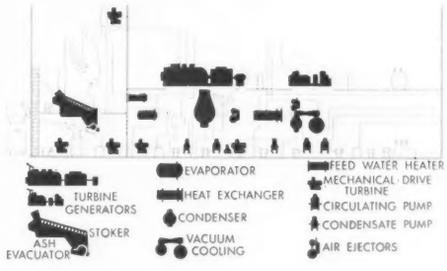

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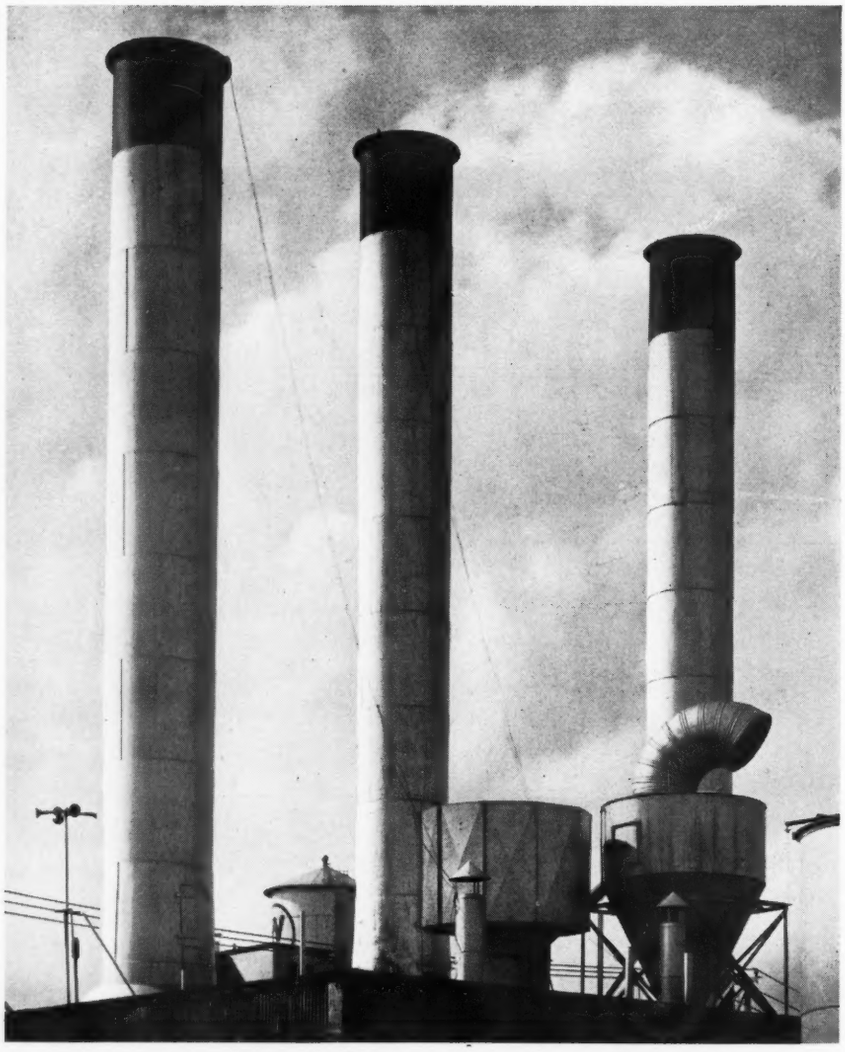
THE REPAIRS YOU *DON'T* MAKE MAY HELP WIN A BATTLE

USE BYERS WROUGHT IRON

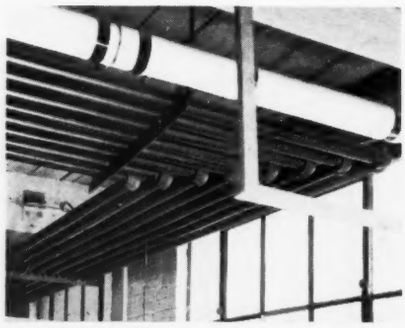
In buying materials for new construction or repairs today, the average engineer is really buying *time*. Lost production may mean lost lives, and must be avoided at any cost.

If you have any applications where corrosion or fatigue limit the life of ordinary materials, it will pay you to find out what wrought iron has done—as an indication of what it might do for you. Our Engineering Service Department will give you authentic field service data on the performance of wrought iron under similar conditions. Ask, also, for our new General Catalog, which lists all Byers products.

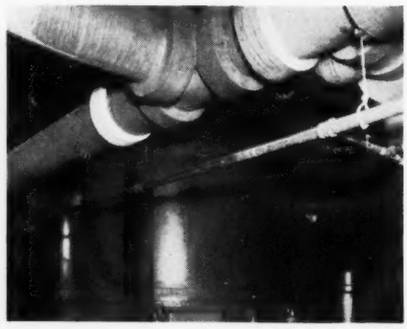
A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.



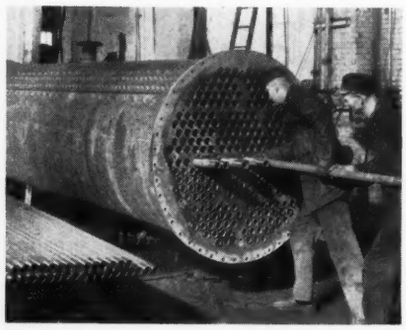
Smoke is sometimes called an index of production . . . but it's often an index of destruction where ordinary stack materials are concerned. Byers Wrought Iron is unusually resistive to the particular corrosive conditions involved, as is shown by the number of stacks erected in the 1890's which are still serving. Our bulletin on flue gas conductors will give you full information; ask for it.



Uniform temperatures are imperative in many industrial operations. These Byers Wrought Iron heating coils provide dependable, trouble-free warmth for an important small-arms manufacturing concern. Ask for piping bulletin.



Water gas generators are essential equipment in many a plant . . . and the unusually severe corrosive conditions are well known. The wrought iron shell illustrated helps to eliminate premature failures and frequent maintenance for an eastern company.



Heat exchangers, regardless of type, generally face severe corrosive conditions. Many engineers have found wrought iron of great value in getting maximum service without repairs. Information will be furnished on request.

Corrosion costs you more than Wrought Iron

BYERS GENUINE WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

STEEL TUBULAR PRODUCTS

POWER

Established 1882 • PHILIP W SWAIN, Editor

Conversion to War in 1942

Forced conversion of thousands of manufacturing plants to war production in 1942 is dead certain. Many readers of POWER will be directly affected.

When Donald Nelson, as all-powerful head of the War Production Board, agreed to "fill" the president's huge "order" for tanks, planes and ships to be delivered in 1942, he knew that these fantastic totals could not be produced with existing war production plants. He knew also that new plants could not be built and tooled in time. As a practical business man he chose the only way out—drastic conversion of existing plants from civilian to war production.

Unlike the old-style camp-meeting "conversion," this 1942 variety isn't something you can take or leave according to your mood. If WPB says the word you convert and like it. Thus the automobile industry was ordered to die and be reborn, "Make no more cars. Convert 100% to war." They shut down the plants, ripped out their famous production lines and scattered their machine tools, until nothing was left but the shells of buildings. In a few months more men will be working in them than ever made automobiles.

The household refrigeration industry got its marching orders: "Rush production for stock until April 30. Then stop dead—not another refrigerator—and convert your plants 100% to war production."

Next in line were radio sets. Production for civilian use had already been cut 40% below 1941 levels. Now the cut is to be 100%. By June 1, or thereabouts, the radio manufacturing industry must be completely converted to war.

Already the typewriter industry has its notice of drastic curtailment of typewriter production, so it can turn out rifles and machine guns.

Who's next? Your industry—if your product is not essential to public health or morale, and if its production uses materials, machines or men that might better be employed on war work. Even if your present product is food or clothing, or some other so-called "necessity," WPB may decide that a smaller amount, or fewer styles, or poorer quality, will have to do until we can put the Axis in its place.

The order to curtail or stop civilian production may or may not tell the manufacturer what war products he should make, or how he should convert his plant. In many cases—perhaps in most—this will have to be left to his resourcefulness. If the manufacturer lacks that quality he may have to shut down his plant and see his men leave to seek war work, perhaps in distant cities.

More often, we think, American ingenuity will find war work to fit the existing buildings and working force, and part of the existing equipment. Already many organizations have met this challenge. A former maker of handbag frames is producing chargers for rapid-fire guns; a manufacturer of heat regulators is building tank periscopes. And a carpet company is machining gun barrels.

This business of forcing a manufacturer to convert his plant "or else" is tough medicine. These violent changes disturb our way of life; they create injustices and inequalities; they destroy billions of dollars in accumulated values. Yet the pill is none too bitter for what ails us—the disease known as "too little and too late."

Where does the power engineer fit into this conversion picture? First, he won't be happy if his plant is shut down through failure to look ahead. Second, he should foresee what conversion is likely, so that he can plan the corresponding conversion of his power services. Third, as a responsible and practical department head in industry, his advice should be helpful to the executive who is anxious to convert but doesn't know how.

Efficiency Boosted at University

▶ RESULTS FROM THE MODERNIZED and expanded heating plant at the University of Idaho (Moscow, Idaho) have surpassed guarantees and expectations. The University began construction of the new pulverized-coal-fired steam generator on February 1, 1940 and put it into service on January 12, 1941. Present plans contemplate the addition of a second unit when further building growth requires additional heating capacity.

This plant furnishes steam primarily for the campus heating system, but also provides substantial service to cookers in the kitchens, sterilizers in science laboratories and experimental apparatus in the chemical and mechanical engineering laboratories.

Basic objectives in equipment selection and in plant design were: (1) high economy under a widely varying load; (2) ability to pick up loads quickly; (3) ease of operation with automatic control of vital plant functions.

The University's heating plant has been moved three times during the history of the institution because of the rapid growth of the campus. The plant of which the new steam generator is now a part was built in 1927 and comprised 10,500 sq ft of boiler heating surface in three units:

One 2500-sq-ft single drum, horizontal water-tube Keeler boiler

One 3000-sq-ft single-drum, horizontal water-tube Keeler boiler

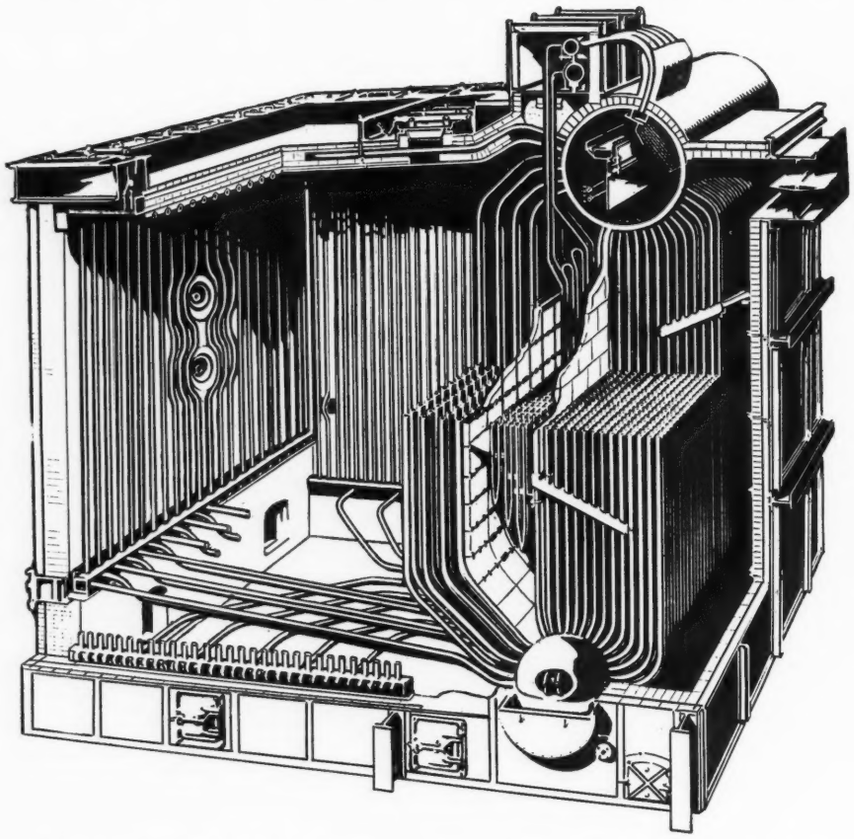


Fig. 1—Water-walled unit has continuous steaming capacity of 35,000 lb per hr

One 5000-sq-ft 4-drum, Stirling water-tube boiler

These boilers were equipped with underfeed stokers of an early design. Stoker hoppers were hand filled and ash was removed by hand and deposited on the ash dump by hand-operated pushcarts. The units were housed in a brick boiler house, having a center bay and two outside wings. They occupied the central bay, with space at the south end for an additional boiler. The auxili-

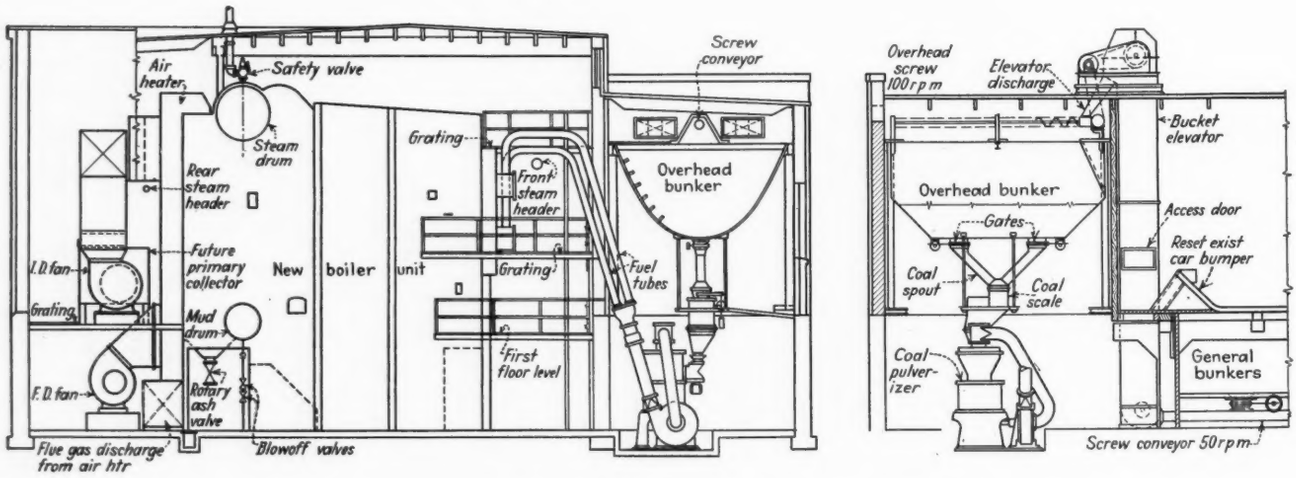


Fig. 2—New steam-generating unit is fired by one pulverizer through two burners

Central Heating Plant

New 35,000-lb-per-hr steam generator and associated equipment, for base heating load, surpass guarantees and expectations. H F Gauss, head of mechanical engineering department, University of Idaho, describes equipment and fuel selection, and cites performance data

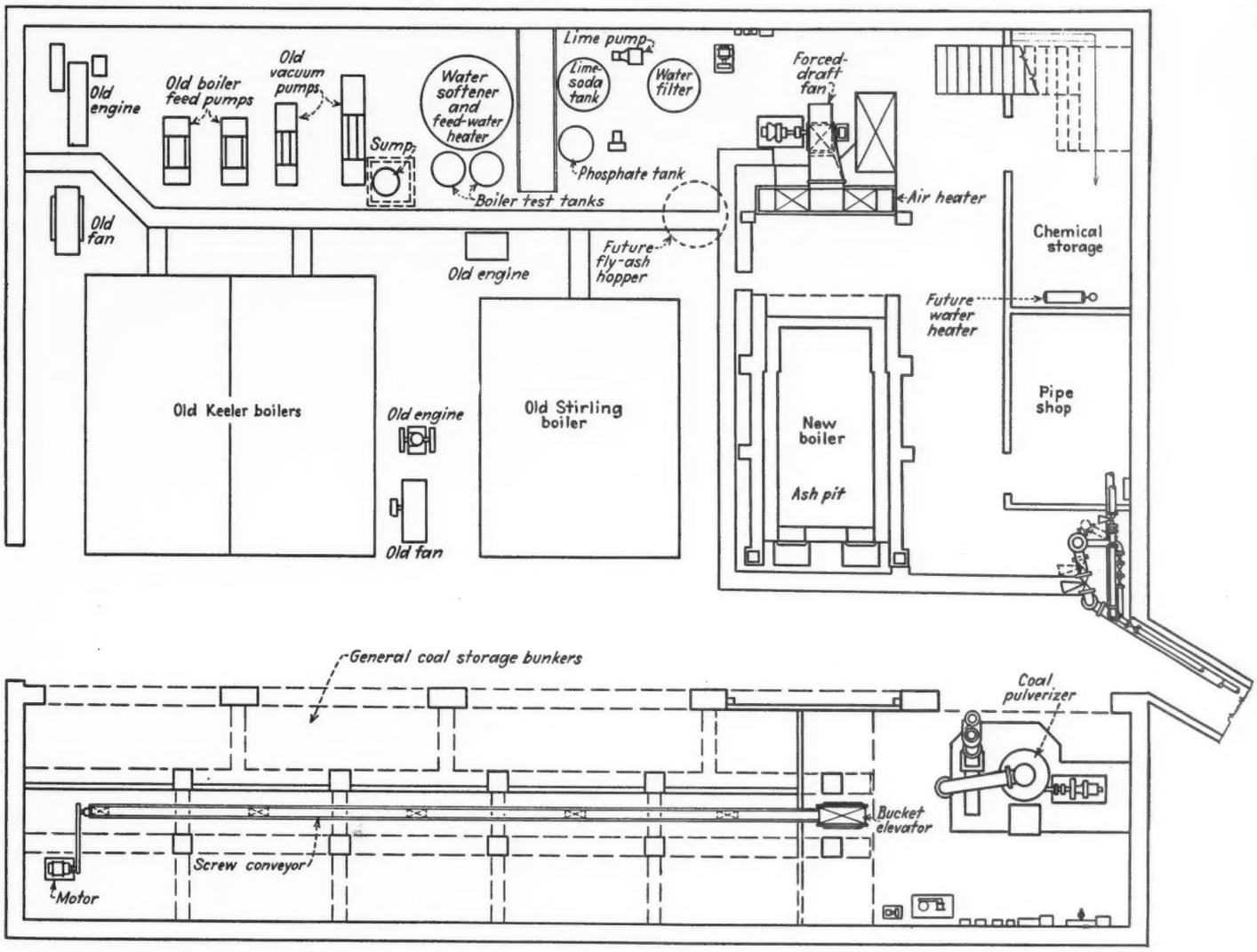


Fig. 3—Ground-floor plan showing old and new equipment

aries occupied the east wing, while the west wing provided coal storage space. Coal was brought into this wing in cars on an elevated track, then dumped and shoveled into the space below.

The old plant lacked room for proper operation. Carefully tabulated operating data and frequent tests showed that the operating efficiency ranged between 50 and 60%, depending upon the coal used and the duration of continuous boiler operation.

By 1939 the rapid growth of the University forced the Board of Regents to consider means of enlarging the heating plant. Choice among the various types of steam generating equipment was not a simple matter. The nearness of lumbering plants suggested the possibility of burning sawmill refuse. Petroleum products for oil burning were available in Spokane, Washington, 85 miles northwest of Moscow.

There are no significant coal deposits in Idaho. Small amounts have been discovered in the southern part of the state, but they are inaccessible and too limited to be considered as a source of fuel for the new heating plant.

Montana, Wyoming, Utah and Wash-

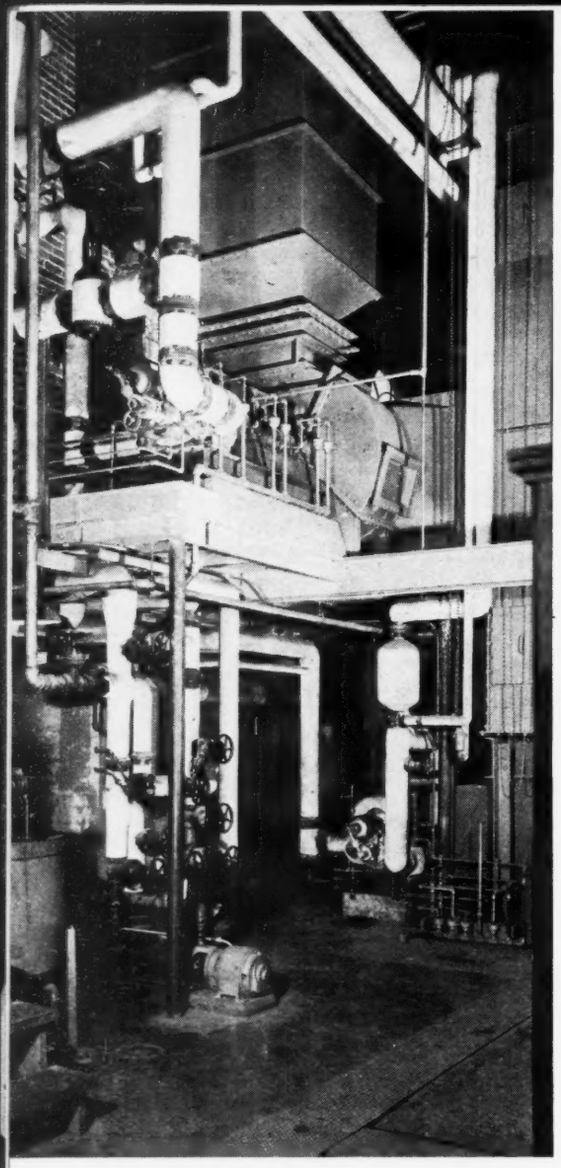


Fig. 4—Turbine-driven forced-draft fan (lower right) and induced-draft fan (above). Turbines exhaust to heating

Fig. 5—Boiler control, now manually operated, will later be shifted to automatic. See page 59 for listing of control units

older boilers could raise the total steam-generating capacity to 70,000 lb when necessary.

Consulting engineer Lincoln Bouillon of Seattle prepared the necessary plans and specifications. No special problems were encountered beyond that of space. All the new equipment had to be squeezed into the relatively small area originally provided for an additional 5000-sq-ft Stirling boiler.

Equipment Location

The H D Powell Plumbing and Heating Co of Moscow, contractors, specified a Combustion Engineering steam generator with Raymond bowl-mill pulverizers and Richardson weigh scales. This 3-pass boiler has one cross drum on top and one mud drum, a water-cooled combustion chamber, an air preheater and forced- and induced-draft fans. A Permutit lime-and-soda water softener was installed with an hourly capacity of 2000 gal of raw water and 7000 gal of returned condensate. The steam and water piping in the boiler room was rearranged. The ground-floor plan, Fig. 3, shows location of new equipment.

The first gallery, where the control panels are located, forms the main operating floor. From this gallery the operator can see the pulverizer, firing aisle on the ground floor, feedwater softener, filter, pumps and fans. On the south side of this gallery are the locker room, lavatory and shower facilities, the super-

ington have an abundance of coal, however, and (though the long haul adds a heavy freight charge to the cost) the certainty of supply led to its selection as the logical fuel. Pulverized-coal firing seemed best suited to local conditions.

Weather conditions at Moscow, Idaho, are not considered severe. Cold snaps are frequent during the winter, but usually are short. Sub-zero temperatures are experienced once or twice a season, but the average is not far from 32 F from the middle of November through March. Steam is kept on the headers, however, from the middle of September until the middle of August.

Records kept by the Department of Buildings and Grounds indicated that a 35,000-lb-per-hr boiler would be the logical choice. A unit of this size could supply all steam needed for the heating system during a large part of the season. Under extreme conditions the

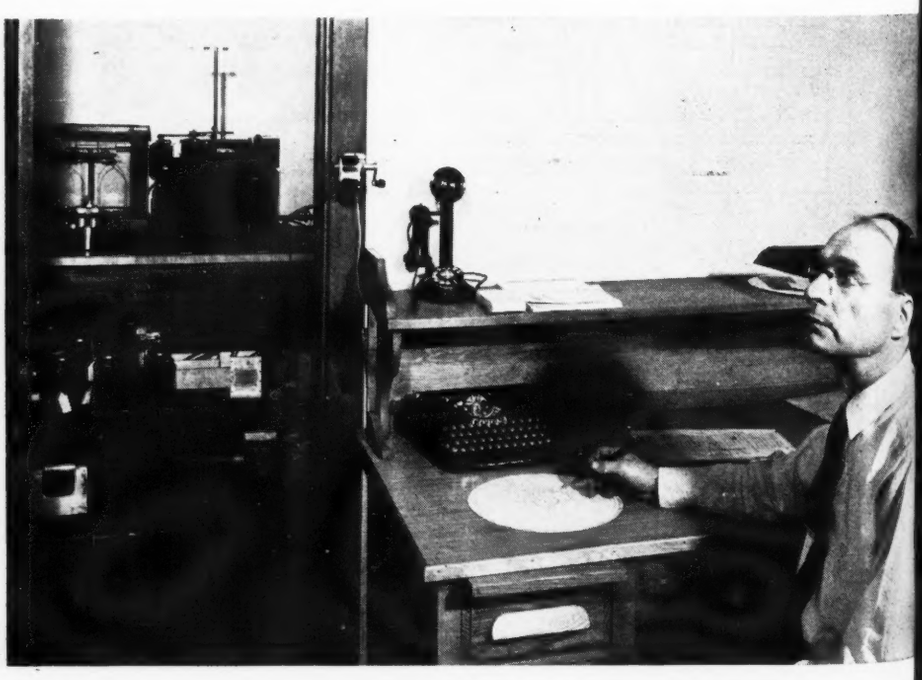


Fig. 6—Plant Superintendent David Radslift has all the facilities of a well equipped laboratory for fuel testing

intendent's office and laboratory for feedwater and fuel analysis.

Burners are serviced from the second gallery. The third gallery, at approximately header level, gives access to such apparatus as water columns, feedwater regulator and safety valves. From this gallery the operators can easily pass to the top of the coal bunker to service the elevator head and distributing screw.

Coal is fed by gravity to the turbine-driven pulverizer from an overhead day bunker through a Richardson automatic recording scale which delivers the coal in 50-pound batches.

All adjustments for fineness in the bowl mill can be made from the outside while the machine is running. The grind is uniform, the classification being maintained within narrow limits regardless of feed rate, amount of moisture in the coal, or degree of wear on the grinding elements. Feed is regulated by adjusting the speed of the feed-driven mechanism, while the primary air is controlled by a damper in the fan inlet pipe. The mill can handle high-moisture coal.

The Bailey combustion control system is used with manual operation at present, but full automatic control will be installed in the near future. The clock at top center of the instrument board (Fig. 5), is flanked on the left by the steam-pressure gage and on the right by the feedwater pressure gage. Immediately below the clock is the 5-point draft gage. Small gages on each side of the draft gage indicate air pressure on the operating side and on the storage side. Below the draft gages are (left) the Bailey steam-flow air-flow meter and (right) the recording meter for feedwater temperature and boiler pressure. Below these meters are five groups of indicators and controls; coal feeder, fuel control, induced- and forced-draft control and flame-failure alarm.

On the flame-failure alarm a red light glows when the flame relay is off, a green light glows when relay is on. The electric-eye apparatus used with the flame-failure system is at the bottom of the panel in the center.

Major New Equipment

Draft fans are driven by steam turbines exhausting to the heating system, so that their steam consumption is of no consequence.

The pulverized coal burners are located about 2 ft 4 in. apart vertically on the longitudinal center line of the generator.

Fig. 1 pictures the arrangement of heating surface in steam generator proper, except that the Idaho unit does not include the superheater shown and that an air preheater attaches to the smoke outlet from the boiler. Following are major units of new equipment:

Pulverizer—Raymond bowl mill, Combustion Engineering Co; maximum capacity—4450 lb per hr; static pressure—6 in. of water; speed 1800 rpm

Burners—Two CE Type VR

Steam generator—CE Type VU

Furnace—Water cooled; heating surface—1398 sq ft; width—8 ft 6 in.; depth—11 ft, 11½ in.; volume—1608 cu ft gross

Boiler—Bent tube, two drum: top drum diam—54 in.; bottom drum diam—36 in.; design pressure—200 psi; operating pressure—100 psi; boiler heating surface—4156 sq ft

Air heater—CE Type VR

Water Softener—Permutit lime and soda; capacity—2000 gph raw water, 7000 gph returned condensate

Coal scale—Richardson automatic

Outstanding feature is the ability of the steam generator to operate successfully at extremely low loads and to maintain high efficiencies at these low loads. As little as 8000 lb of steam per hour has been generated continuously with one burner only in operation. It was feared at the outset that the very limited space available for the installation would prove a serious handicap. This has been found not to be true, however, as no difficulty in the operation of the plant has been experienced.

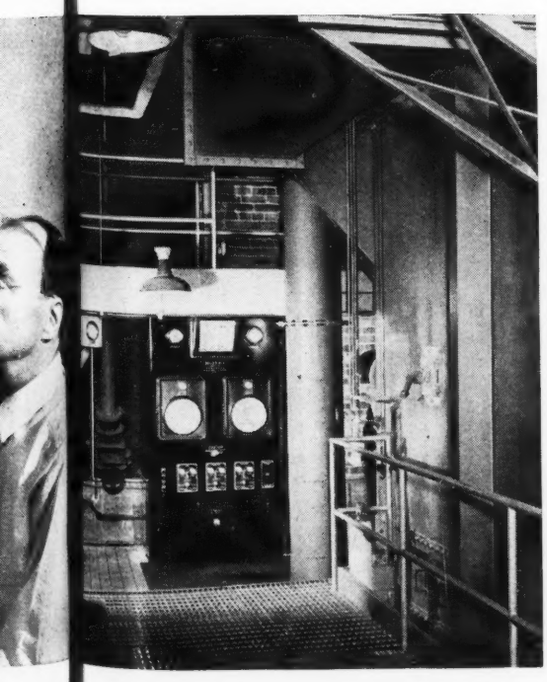


Fig. 7—Part of south aisle of operating floor. Portion of south boiler wall at right and boiler control panel in back

Performance Data

COAL USED: The guarantees were based on coal from the Roslyn Mines in the state of Washington. The characteristics are:

Screen size—¾ in. washed slack	Volatile matter—37.1%
Heating value—12,500 Btu per lb as fired	Ash—13.9%
Fusion temperature of ash—2350 F	Moisture—4.5%
Fixed carbon—44.5%	

EXPECTED PERFORMANCE:

Pounds of steam per hr, actual	13,000	25,000	30,000-max cont	35,000-4 hr
Feedwater temp to boiler, F	210	210	210	210
Exit gas temp from air heater, F	260	293	307	324
Overall efficiency, %	84.2	86.0	85.5	85.0

ACTUAL PERFORMANCE (tests observed by author):

Pounds of steam per hr, actual	8699	13,989	24,515-max cont	33,586-4 hr
Feedwater temp to boiler, F	163	185	159	162
Exit gas temp from air heater, F	251	251	308	330
Overall efficiency, %	83.0	85.62	86.14	85.92

How to Choose Among Heater

Where closed feedwater heaters are part of the condensing-turbine cycle, the heater condensate and its Btu's can be returned either by flashing or pumping. Each has practical advantages, outlined by I J Karassik and W P Spining, Worthington Pump & Machinery Corp

▶ TWO BASIC METHODS are available for returning heater drains to the boiler-feed cycle of a condensing turbine arranged for feedwater heating by extraction steam. Drains can be flashed to the steam space of a low-pressure heater or pumped into the feedwater piping at some high-pressure point. These two methods, however, can be applied in several ways.

Condensate drains are returned to the feed cycle to avoid waste of water and its heat content. A small amount of pressure energy would also be lost if these drains were wasted. A thorough consideration of the various factors involved will aid in selecting the most practical solution to the problem of an individual installation.

As it leaves the hotwell of a closed heater, condensate is at flashing temperature; that is, if it is passed to a region of lower pressure, part will become steam and part remain as cooler liquid. Piping each drain to the next lower heater, Fig. 1, is by far the simplest mechanical arrangement and requires no power-driven equipment. This "cascading" is accomplished by an appropriate trap in each heater drain.

As the trap discharges condensate into the steam space of the next lower pressure heater, part will flash into steam and the remainder will be cooled to the temperature corresponding to the lower pressure. Flashed steam mixes with extraction steam entering the heater and thereby reduces the amount of extraction steam required. The portion that has remained liquid drains directly to the hotwell and mixes with condensate produced by the heater.

A series of heaters can be drained by cascading from heater to heater in the order of descending pressure, the lowest being drained directly to the condenser. If, as is usually the case, one of the heaters is a direct-contact unit, high-pressure drains between it and the boiler cascade until the drains mix with the main flow in the contact heater. Drains from lower closed heaters cascade to the condenser.

Heater drains must be discharged continuously as they accumulate but some means must be provided to regulate the flow in order to prevent steam from blowing through. This is usually accomplished by means of a self-contained trap or drainer. Where large flows have to be handled, a regulating valve is employed, operated by a float located either in the hotwell of the heater or in a separate float chamber. This regulating valve may be either direct or pilot operated. In any case, it is imperative that a sufficient pressure differential should exist under all load conditions to insure an adequate flow. Where all heaters are supplied with steam from uncontrolled bleed points on the turbine, sufficient differential will usually be maintained automatically, but if one heater is supplied from a different source or if any heater pressure is pegged independently of the others, pressures should be checked over the entire load range in order that a trap may be selected to have adequate capacity under worst conditions.

The only mechanical difficulties likely to be encountered in cascading heater drains are (1) damage to the trap caused by wiredrawing and (2) erosion of piping from high velocities downstream of the trap. Careful selection of trap size and material will usually preclude trouble from the first source. For high pressure differentials, it has sometimes been found that a throttling orifice in series with and downstream of the trap will prolong trap life.

Some experimental work is also being carried on with a view to eliminating traps by using only throttling orifices. Erosion in trap discharge lines is still a matter for study. Where lines are short and direct with a minimum of sharp bends or elbows, trouble is seldom experienced. Where erosion does take place, a larger line does not always provide the answer, since the steam-water mixture velocity may increase from more flashing in the line itself.

The alternate of pumping all heater drains into the boiler-feed system, Fig. 2, requires consideration of all possible operating conditions that might affect the prevailing pressure at the point of reintroduction. The absolute maximum pressure at this point determines the design of the heater drain pump, which under no conditions can fail to deliver an excess over this predetermined maximum so that adequate drainage is provided at all loads. Further, the pressure at the discharge point must never fall below the heater pressure or the heater drains will flash in the feed header,

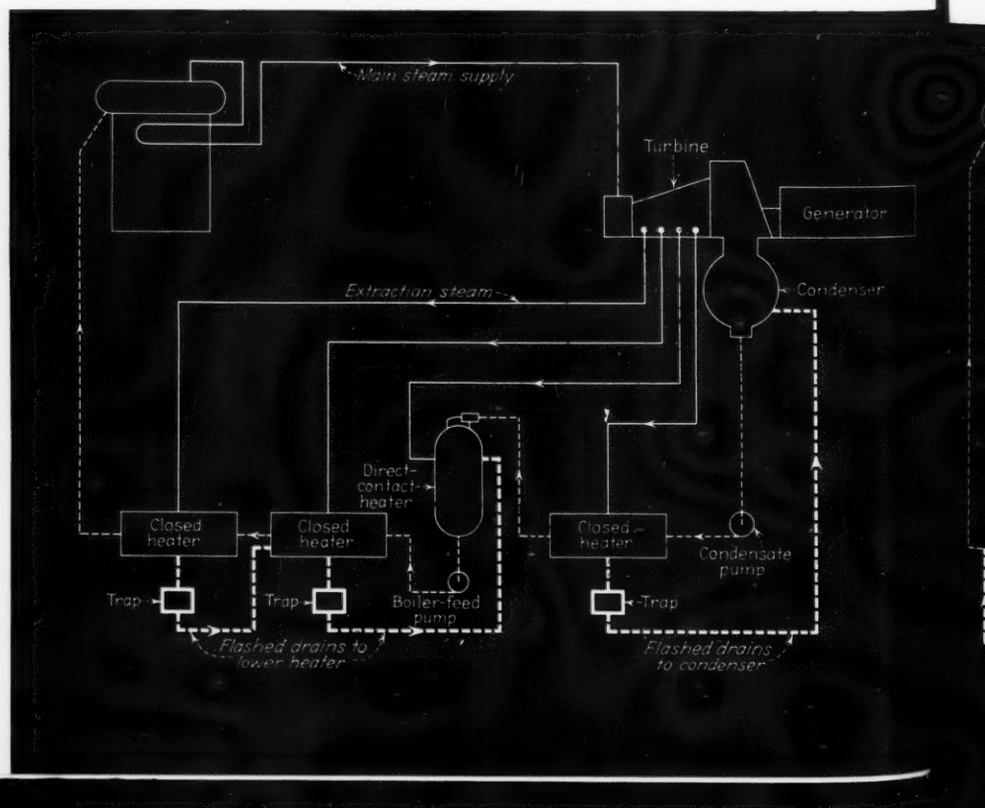


Fig. 1—Cascading to the next lower heater requires no power-driven equipment but is less efficient than pumping. Traps and orifices control flow

Drain Recovery Systems

with consequent water hammer and possible damage to pump equipment.

The heater hotwell should never be drained dry, as this would cause the heater drain pump to become vapor-bound. This can be prevented by installing a float-controlled valve in the discharge of the drain pump, the function of which is to interrupt the flow before all the condensate is drawn from the heater hotwell. Also, to prevent operation of the pump against a completely closed discharge, a small bypass connected back to the hotwell should be arranged to open whenever the float-controlled valve is closed. A simpler alternate is to keep the bypass open at all times, as it has but little effect on efficiency of the installation.

Heater drain pumps, usually motor-driven centrifugal units, are designed specifically to suit individual plant conditions. For the low-pressure end of the feed cycle, the pressure and temperature requirements are not particularly severe, usually below 50 lb and 212 F. However, very low submergences require pump design similar to that of condensate pumps, especially in regard to operation of the inlet under partial vacuum.

On the high-pressure side, drain pumps may have to develop a pressure comparable with that of the boiler-feed pump while handling flow of only 5-10% of the quantity. Add to this the usual condition of low submergence at high suction temperature and pressure and the pump design problem becomes complex. Suction conditions dictate low operating speeds, unsuited to generation of high heads in small capacities. As a result the design of such heater drain pumps must be a compromise between two contradictory requirements.

Where such a compromise becomes impractical, heater drains can be introduced into an intermediate stage of the boiler-feed pump if the design lends itself to such a solution. The range of pressures and temperatures in each stage of the boiler-feed pump must be analyzed for all operating loads to guide the choice of the stage most suitable for reintroduction of the drains. Then the drain-pump design can be fixed between two limits: (1) the minimum discharge pressure of the boiler-feed-pump stage preceding the introduction of the heater drains must not fall below the vapor pressure corresponding to the maximum temperature of drains to avoid flashing, and (2) the minimum discharge pressure of the drain pump must exceed the maximum pressure in the feed-pump stage to insure drainage at all times.

It is important not to overlook conditions which might be set up in the boiler-feed pump if the latter is operated at variable speed. A condition may be created in which the discharge pressure and stage pressures may be considerably lower at light than at full loads.

A typical arrangement for pumping drains into an intermediate stage of the boiler-feed pump is shown in Fig. 3, which also illustrates the location of the float-controlled throttling valve and the bypass back to the heater hotwell. These precautions, of course, are required when the heater drain pump discharges into an intermediate stage of the boiler-feed pump as well as when it discharges into the boiler-feed header.

Materials for drain pumps deserve serious consideration. For high-temperature drains exceeding 300 F, cast steel is recommended even though cast-iron or semi-steel would be satisfactory on the basis of strength alone. Again, because of temperature conditions, stainless-steel impellers and fittings throughout are definitely recommended to avoid unequal radial and longitudinal expansion between bronze impellers and steel pump parts.

Because of high pressure and temperature at the suction, stuffing boxes should be deep and adequately cooled. This combination will lengthen packing life and prevent flashing of leakage into steam as it reaches atmosphere.

With knowledge of practical limitations inherent in cascading systems or drain pumping, an economic comparison of efficiencies should be made by the usual heat-balance calculations with which power-plant designers are familiar. Generally the best arrangement is neither all-flashing as in Fig. 1, nor all-pumping as in Fig. 2, but some compromise between the two. In the scheme shown in Fig. 4 high-pressure drains are cascaded down to the contact heater while low-pressure drains are pumped into the line just before the contact heater. In the absence of a direct-contact heater, drains cascade to the lowest closed heater and are then handled by a single pump.

Considering thermal efficiencies only,

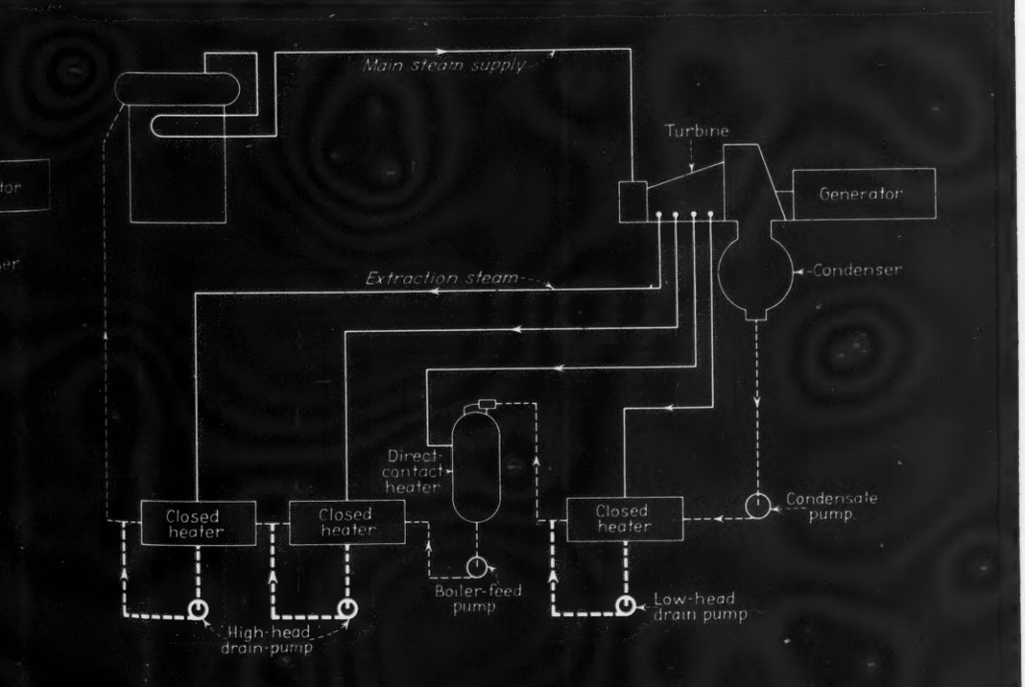


Fig. 2—Pumping all drains requires a separate pump for each closed heater. Low-submergence high-head requirements present difficult pump-design problems

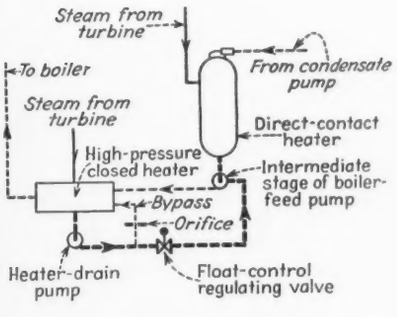


Fig. 3—Introducing the drains into an intermediate stage of the boiler-feed pump requires a very careful study of all possible operating conditions

heat balance studies of numerous specific cases indicate that there will be again in over-all plant performance of about 1% for the all-pumping system of Fig. 2, over the all-flashing system of Fig. 1. The combined flashing-pumping system of Fig. 4 is about ¾% better than all-flashing and ¼% poorer than all-pumping. These values will, of course, vary somewhat for different plant conditions, but they are suitable for preliminary comparisons.

Added economy gained by the installation of individual drain pumps at each closed heater is seldom justifiable in view of the added initial expense for only the last ¼% of performance. A single low-pressure pump, on the other hand, seems well paid for by ¾% improvement over the all-flashing system.

From an operation and maintenance standpoint, the combined flashing-pumping system also has advantages. Traps or drainers need practically no attention during starting and stopping periods. Likewise they require only routine periodic inspection and are, by virtue of their lack of high-speed moving parts, less subject to failure, renewal or replacement than heater drain pumps. The disadvantages of pumping are not so serious where only a single low-pressure drain pump is employed. Draining the lowest pressure heater imposes no unfavorable pressure or temperature conditions, so no difficult design problem nor unusual expense for the pump is entailed. At low pressures there is little maintenance or failure hazard.

Numerous variations of the three fundamental systems described here will occur to operators as best suited to their individual needs. One alternate is the inclusion of a drain cooler to recover a part of the sensible heat that would otherwise be lost if the drains are flashed to the condenser. Such a system has the simplicity of flashing combined with part of the efficiency gain of low-pressure pumping. However, the drain cooler necessarily has a low heat-transfer rate, relatively large size and can never quite equal the efficiency of the system of Fig. 4.

Any final decision must be made on the basis of relative importance of economy as against simplicity and reliability. The factors outlined here provide the items that should enter a careful comparison of available methods.

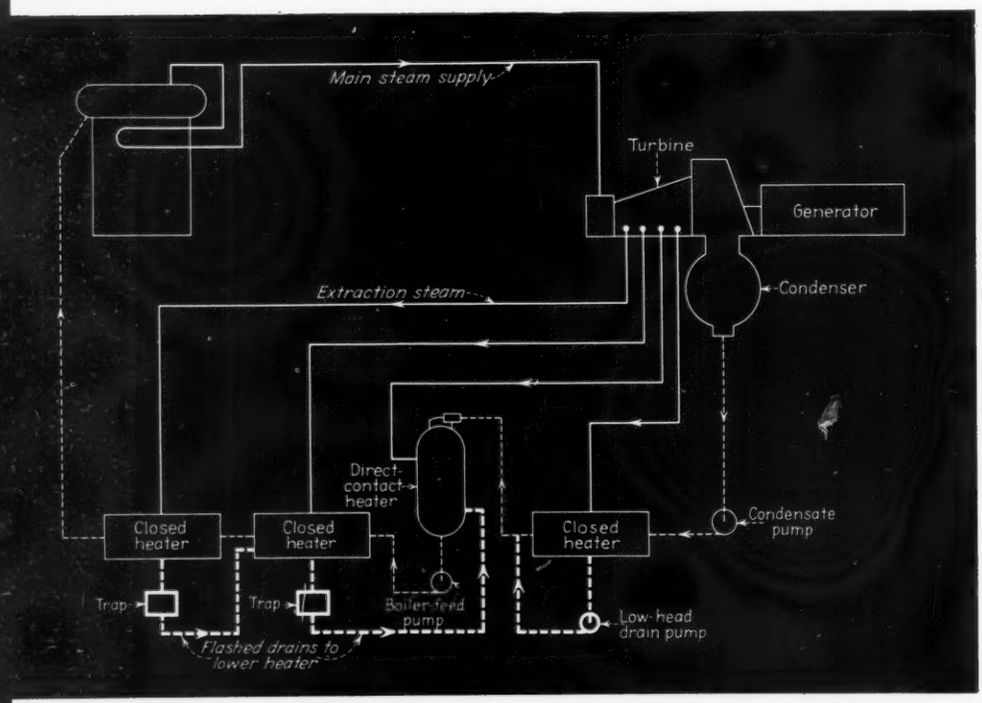


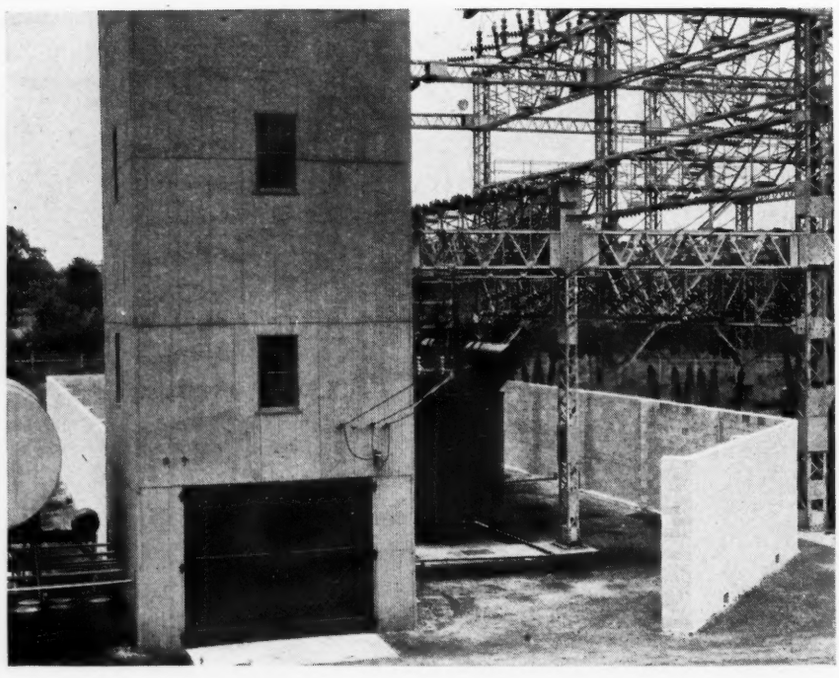
Fig. 4—Modified cascade system requires only a single pump at the lowest pressure closed heater. It is nearly as efficient as pump arrangement of Fig. 2

✦ ✦ ✦

Foils Saboteur

Yankee ingenuity calls on the homely concrete block to protect this transformer substation from the effects of rifle fire by potential saboteurs. A 10-ft. high barrier extends nearly all around the transformer bank shielding the tanks and radiators from all angles exposed to fire from outside station area, in addition, a steel fence, equipped with an inductive alarm system completely surrounds the area. Hollow concrete blocks require no strategic materials or priorities and can be salvaged for post-war use.

(Acme Photo)



Automatic Voltage Regulators Improve Kilowatt Quality

A M Shong, regulator engineer, Allis-Chalmers Mfg Co, specifies the requirements that must be satisfied by automatic-voltage regulators, alternating-current generators and their prime movers before the regulator can do its job of holding voltage constant

▶THE MODERN AUTOMATIC VOLTAGE regulator occupies an important place in the power plant, particularly because, for reasons of economy, modern ac generators have poor inherent regulation. Each change in load on the generator causes a corresponding deviation from normal or desired voltage which must be corrected by a change in field excitation to bring generator voltage back to normal.

Automatic voltage regulators for ac generators actuate the rheostat connected in the shunt field circuit of the exciter. A voltage change causes a mechanism to move and change the rheostat setting, thus increasing or decreasing the resistance of the exciter field circuit. This causes a change in exciter voltage in the proper direction to restore generator voltage to normal. All regulators must efficiently and quickly change the resistance in the exciter field circuit without causing hunting (periodic oscillation).

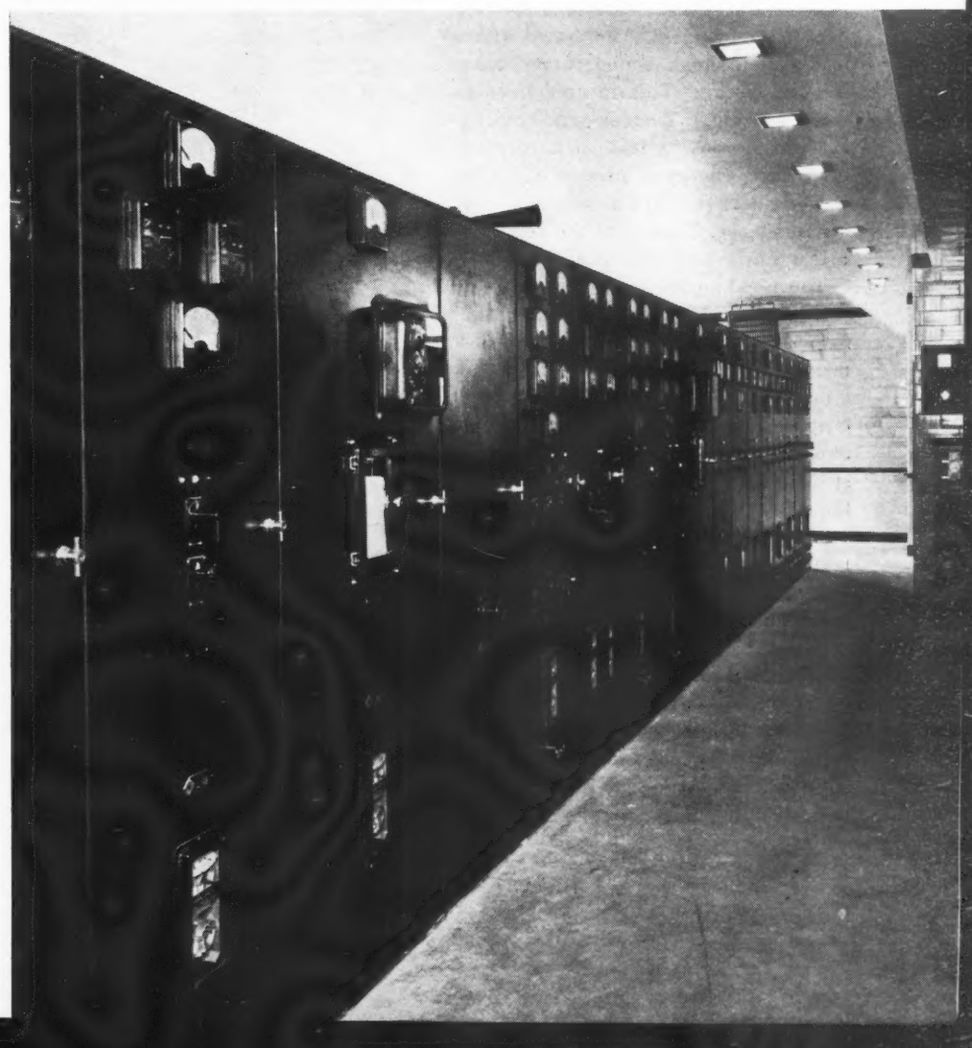
One of the oldest regulators consists of one or more sets of contacts which vibrate continuously, periodically shorting out or inserting a block of resistance in the exciter field circuit; the effective resistance in the circuit depends on number of vibrations per second and duration. In carbon-pile regulators, a stack of carbon disks or plates is connected in series with the exciter shunt field. Changing the pressure on the carbon elements adjusts the stack resistance. Stack resistance is low when compressed and high when compressing force is removed. Other regulators vary the resistance in the field circuit by contacts that short out sections of the field rheostat. In still another device, two rocking sectors on two curved commutators automatically adjust the exciter field resistance as shown in the simplified diagram, Fig. 2.

In Fig. 2 the motive system consists of a voltage sensitive torque motor M_1. This split-phase torque motor has a thin, hollow aluminum drum rotor *D* carried by a steel shaft in jewel bearings. Torque produced by the current in the field windings of the motor is counterbalanced by a spring *S*, which produces a constant torque for all drum positions. Thus, a voltage rise on the torque-motor winding causes its rotor to revolve in one direction and a voltage drop to reverse the rotation.

The exciter field rheostat, which is an integral part of the regulator, is built in two sections of a commutator. Stationary commutator bars *C*, to which the resistances *R* connect, are arranged concentrically with the rotor shaft. The inner sides of the commutator bars facing the shaft have a V-shaped groove that guides the rocking contacts *B*. These are sector-shaped, with a curved strip of carbon as contact surface. By rotating 60 deg rotor *D* causes contacts *B* to rock in the grooves of the commutators cutting in or out all resistance. The location of the point of contact is indicated by the pointer *P* on a scale. When the pointer is in position 4 all resistance is in the exciter field circuit and in position 0 all resistance is cut out.

The torque-motor field winding connects directly to the alternator terminals, Fig. 2, or through a potential transformer if the alternator voltage is over 125. For a steady condition the torque-motor position inserts enough resistance in the exciter field circuit to produce normal voltage at the particular load on the alternator. As load increases, voltage will tend to drop be-

Fig. 1—Three automatic voltage regulators maintain constant voltage on three turbine-generators operating in parallel in a large modern municipal power station



cause of the inherent regulation of the alternator. This voltage drop reduces the torque of the motor below that of spring *S* and rotor *D* turns through an angle to rock contacts *B*, reducing the resistance in the exciter field circuit and restoring the alternator voltage to normal. For a decrease in load the reverse occurs.

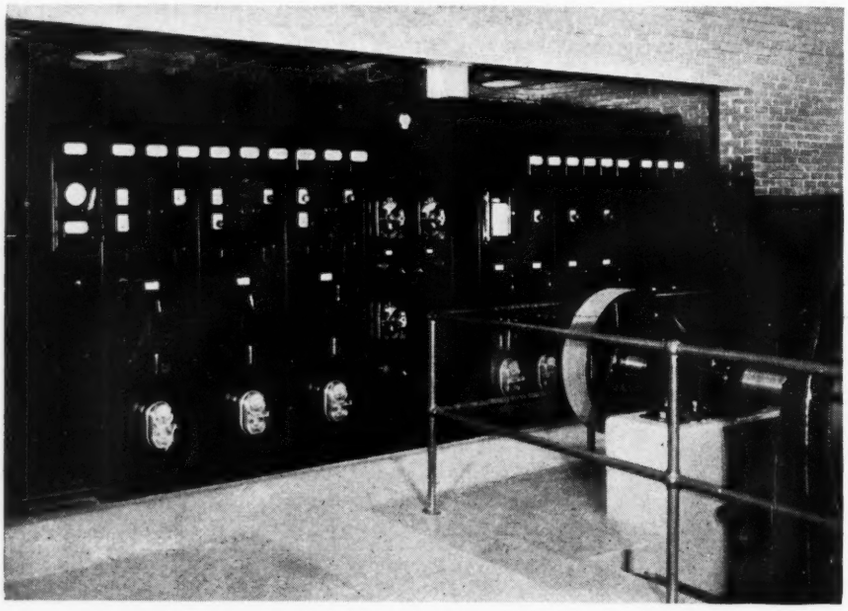


Fig. 3—Automatic voltage regulators on this switchboard maintain constant voltage on three engine-driven alternators in an industrial plant

As contacts *B* rock over the commutator, they make contact on a new bar before leaving a preceding one. In this manner a resistance change in the exciter-field circuit is accomplished with a make-before-break action, never opening the circuit. This insures freedom from sparking, burning and pitting. Since only rocking friction is encountered, little energy is needed and little movement is required to cut in or out all resistance. Therefore, the regulator acts quickly and sensitively.

The regulator is provided with a recall device which eliminates hunting. It consists of a disk *A* between two permanent magnets *M*. Disk *A* is geared to a rack of a sector *E*, which can turn concentrically with the spindle of rotor *D* and is fastened to it by a helical recall spring *F*. This coupling spring between the rotor shaft and the disk is made weak enough to allow powerful over-regulation and yet maintain stability.

A satisfactory automatic voltage regulator must be: (1) sensitive to the slightest change in generator voltage caused by load changes, (2) capable of fast response, to initiate a corrective action with least possible delay, (3) capable of powerful field forcing to restore voltage to normal as quickly as possible. It must accomplish all three without causing hunting. In addition the voltage regulator must be free from temperature and frequency errors and must automatically distribute wattless load between paralleled generators. It must also be capable of handling the complete voltage range of the generator, not only from no load to full, but with extra range at each end for field-forcing to overcome the magnetic time lag of the highly inductive generator and exciter field circuit.

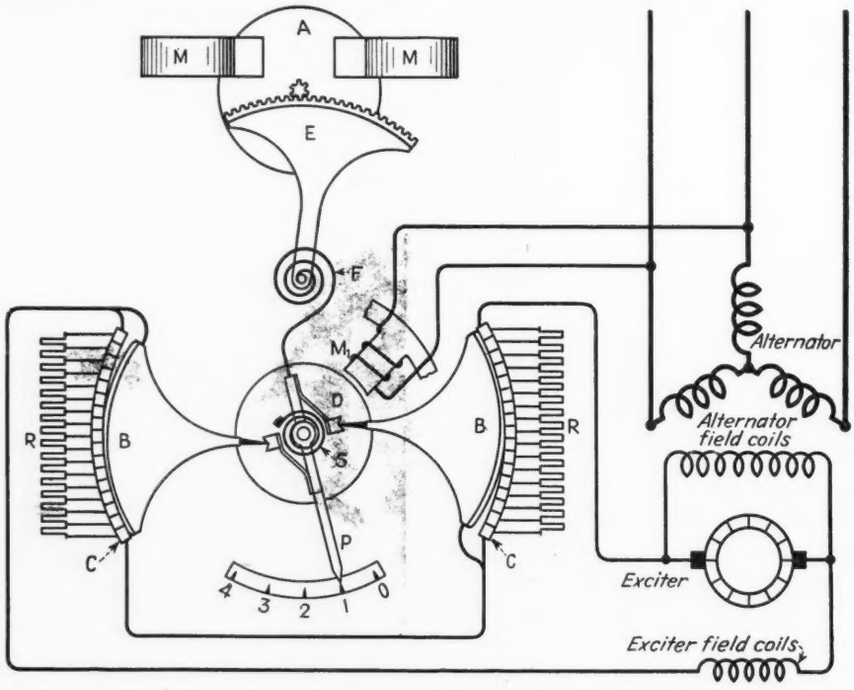


Fig. 2—Simplified diagram of a rocking-contact automatic voltage regulator

However, even the best regulators are not cure-alls for poor generator voltage regulation. Before any regulator can do its job properly several conditions must be satisfied in the generators and their prime movers:

1. Generating capacity must be large in proportion to the load change, or the generators will be temporarily or permanently overloaded, usually by reactive kva due to excessive low-power-factor current when large motors start. Regulators cannot make up for a deficiency in generating capacity.

2. Speed regulation of prime mover must be good or the generator will not receive its share of energy change when there is a load change. Unless this condition is met a serious voltage change will occur with load change putting an extra burden on the voltage regulators which often cannot cope with the problem caused by exciter shortcomings, also affected by speed changes. At best, the voltage change will be much more severe and serious and undesirable frequency changes will result if speed regulation is poor. Invariably the regulator is blamed as the apparent trouble is evidenced by voltage changes, the correction of which is actually beyond the regulator.

3. Generating equipment must be in good mechanical condition. Troubles which must be corrected before good voltage regulation can be expected are slipping of exciter and generator belts, loose connections, sparking at exciter commutator and alternator slip rings,

(*Continued on page* 132)

Which Governor Suits Your Turbine Load?

Engineers seldom have need for specialized knowledge of various governor designs but should know what types are available and how to apply them to variable electric and process loads

By F K FISCHER and O N BRYANT
Westinghouse Electric & Mfg Co

▶ THROUGH A GRADUAL EVOLUTION, steam turbine governors have advanced from early speed-load control to present-day specialized devices that hold extraction or backpressure constant, limit throttle steam, absorb a predetermined part of load swings and in many other ways act to supervise turbines under widely varying industrial requirements. Design of control and relay devices is the field of a few specialists; proper application of such devices requires that plant engineers have thorough knowledge of controls available and within what limits each can function.

For speed governing, the basic problem is to allow just enough steam to flow into the turbine to generate the required output of power. More steam would then cause speed to rise; less would let it fall. Thus if the control decreases steam flow as the speed rises above some set value, a state of balance is soon reached.

The usual governor measures speed and controls steam flow by opening and closing valves in response to speed variations. For example, at 100% speed, valves may be wide open and at 104% speed entirely closed. Such a *speed-responsive* governor would be said to have "4% regulation."

A number of additional control devices have been developed that greatly extend the automatic operation of turbines. These offer many real advantages to their users by adding to reliability and adaptability of the machine and relieving the operator of much unnecessary work.

Such controls work with and are an addition to the speed governor. Some operate by setting the position of the speed governor while others control the valves directly. For the latter, the speed governor is backed off by the speed changer when the auxiliary device is in command. However, the speed governor is always left in position to take over control and protect the turbine against excessive overspeed.

Special control devices have been developed for special turbines and conditions under which the latter must operate. Basic turbine types correspond to fundamental requirements of their application:

1. The condensing turbine provides electric power where there is little or no demand for process or heating steam
2. The noncondensing turbine serves a demand for steam at exhaust pressure large enough to justify use of a turbine instead of a reducing valve; power generation is roughly proportional to steam flow, hence power demand should coincide with steam demand or be greater than the power equivalent of the steam demand
3. The extraction turbine combines a noncondensing and a condensing turbine in one casing for conditions of heavy demand for power with little demand for steam but where there is normally some steam required
4. The mixed-pressure turbine is like the extraction turbine except that it takes in low-pressure steam from some variable source such as a waste-heat boiler
5. The extraction-mixed-pressure turbine can either extract or induct low-pressure steam depending on whether a deficiency or surplus of such steam exists.

Auxiliary governing devices are called into service to regulate pressures and temperatures, limit steam flows, control electric load or frequency and provide for safe operation. While the variety of special applications calls for many individual mechanisms, they can be grouped into the several classifications.

Extraction or induction control has been developed to a point where steam can be automatically extracted at two

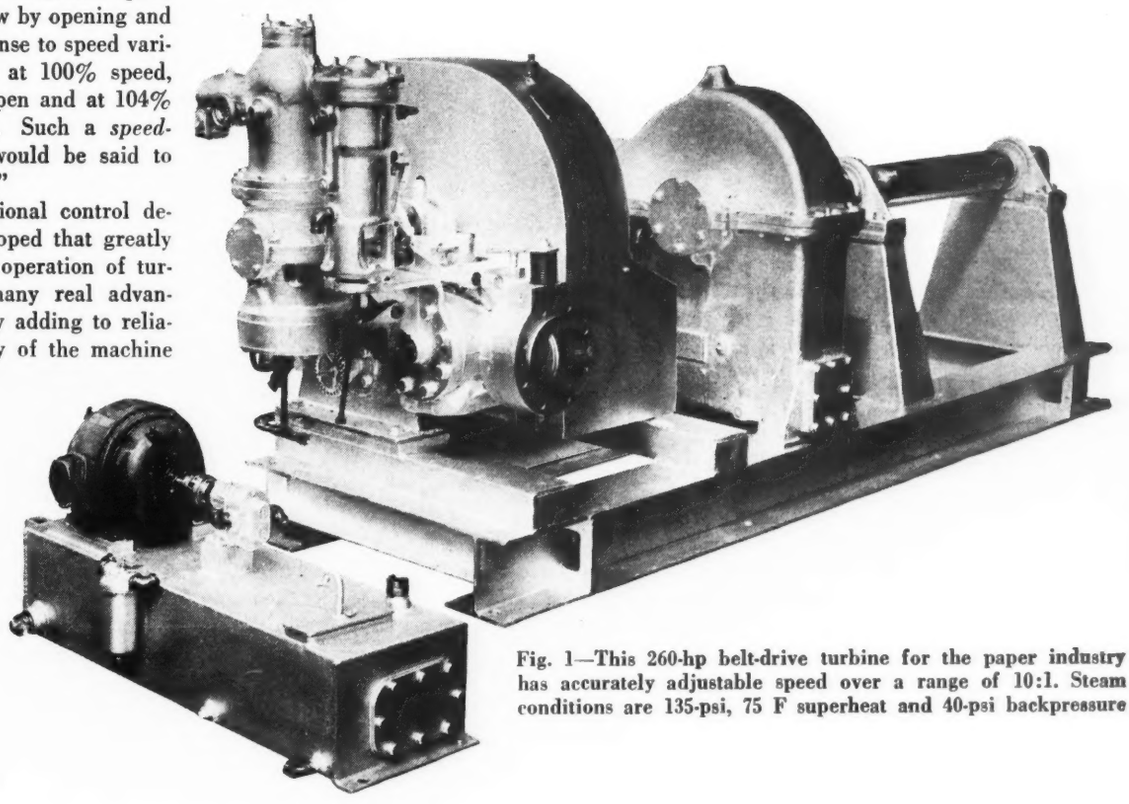


Fig. 1—This 260-hp belt-drive turbine for the paper industry has accurately adjustable speed over a range of 10:1. Steam conditions are 135-psi, 75 F superheat and 40-psi backpressure

different points of the turbine. Steam can also be inducted at one or both points when excess is available. The speed governor controls the turbine load and maintains speed while the extraction mechanisms hold pressure at the extraction points nearly constant. The control is fully compensated, that is, the control mechanism will make the necessary change in any one of the regulated quantities such as load or extracted steam and then automatically readjust all the other regulated points so that their flows or pressures are not disturbed.

Steam-flow limit control has principal application in central stations. By an automatic limit on the position of steam admission valves, the turbine load is held below a predetermined value. For example, where two boilers supply a turbine and only one is in operation, the control can be set to admit only the steam flow the one boiler can supply. This device can also serve to hold base load so that normal variations in demand are taken on other, usually less efficient, units.

Backpressure regulation controls the exhaust pressure of a noncondensing turbine by varying the steam flow to the throttle to conform to exhaust steam demand. With this control turbine load varies with exhaust steam demand. The backpressure regulator controls neither speed nor load so can be used only if the generator is operated in parallel with speed-governed units.

Inlet-pressure control regulates the amount of steam flowing to the turbine according to the available supply, as from a waste-heat boiler. The device is similar to a backpressure regulator but working in reverse. With the backpressure regulator, an increase in exhaust pressure indicates too much steam flow and the regulator closes inlet valves. With an inlet-pressure regulator, on the other hand, a steam pressure increase causes opening of the turbine admission valves. The generator must be operated in parallel with other speed-governed units.

Electric load regulation controls the turbine speed governor so that a given turbine-generator unit or units will absorb all or any predetermined portion of a load swing. It has wide application in steel mills, paper mills and other industrial plants that experience rapidly changing loads. Where purchased power supplements local generation, this control can be utilized to limit the load peak demand on the incoming line.

Earlier electric load regulators were so slow in their response as to be unsuitable for rapidly changing conditions. Now, however, it is possible to handle changes as fast as the boilers can supply the necessary steam. Thus purchased power can be obtained at a favorable peak-demand factor, often at a considerable saving in over-all power cost.

Speed-compensated governor control makes it possible to operate the governor with instantaneous wide regulation for stability and gradually compensate to an extremely low net regulation. To operate any speed governor satisfactorily in parallel with other units it is necessary to have some degree of regulation, the latter being defined as the speed change required to move the governor servomotor through full load range. In general, the greater the regulation the more stable the operation. In some instances, however, it is required to operate at regulation much less than that essential for stability. The speed-compensated governor, principally applied to paper mills and other isolated generating plants, allows a rather great instantaneous fall-off in frequency on rapidly increased load but gradually restores the system close to the original condition.

Other special controls hold inlet and exhaust temperatures at set values. Still others are responsive to the requirements of driven machines. A good example of development for a particular requirement is the load limit control with low-frequency release for spinning reserve of a hydro system. The load limit is set to keep the steam tur-

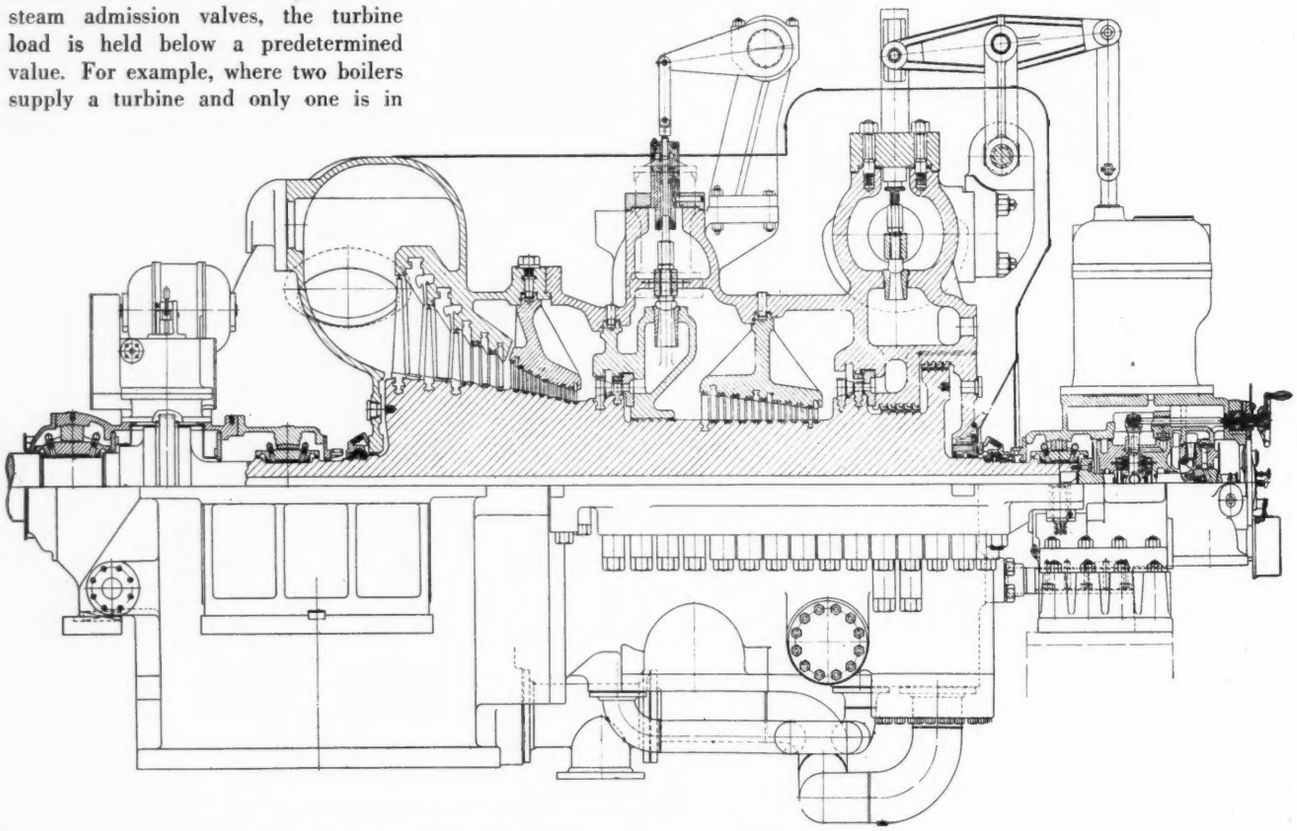


Fig. 2—Automatic-extraction valve gear of 15,000-kw 3600-rpm single-cylinder turbine for 600-psi 725-F with extraction at 140-psi

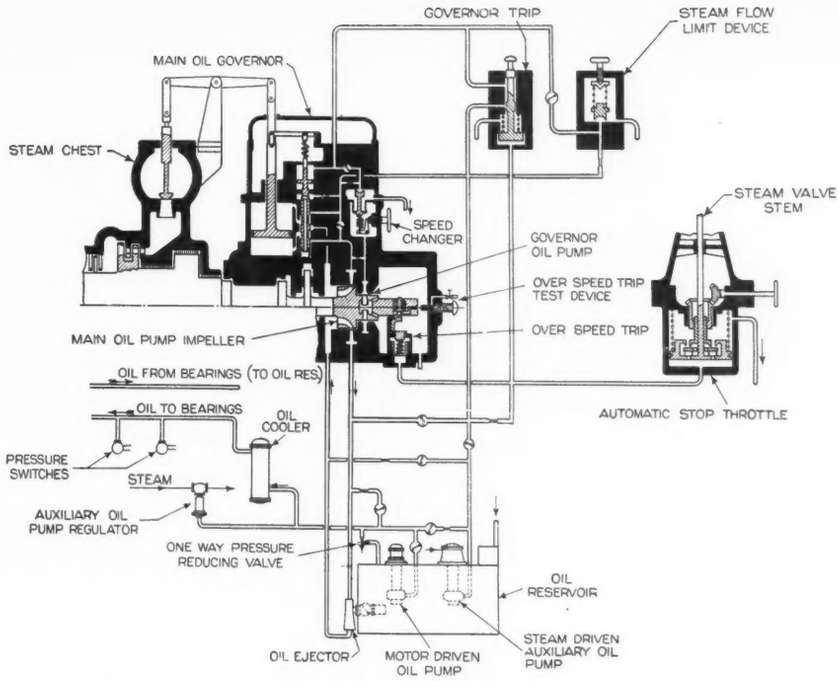


Fig. 3—Lubricating-oil and governor-oil system of speed-responsive governor with trip device, flow-limit control and relay mechanism in compact arrangement

bine running with light load. As long as other sources of power can handle the demand, system frequency is maintained within predetermined limits. If frequency drops more than the set amount, indicating that an emergency condition exists, the low-frequency release takes control away from the load-limit device and the steam turbine governor immediately picks up load to restore system frequency.

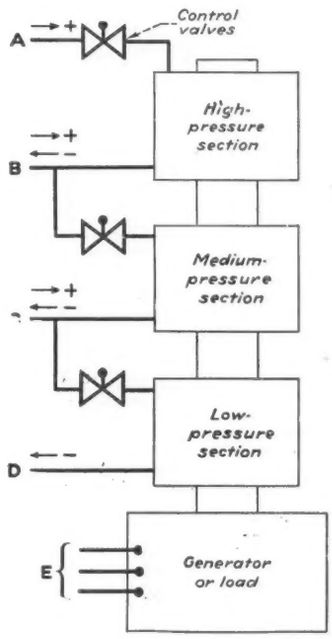
Safety devices include trips for low oil pressure, overspeed, reverse current, rotor end-travel and low vacuum.

The variable-speed governor replaces the usual speed governor where control is necessary over speed ranges as great as 25 to 1 within an accuracy of 1/2% at any given setting. This type of governor is widely used in paper-mill drives and rayon spinning for a wide, accurately controlled speed range.

This tabulation enables operating engineers to determine the effect of establishing control over some of the flow or load conditions. Other factors must follow if operation is to continue.

OPERATING CONDITIONS	High-press. flow	Med. press. flow	Low press. flow	Exhaust flow	Load
1 Straight condensing or non-condensing	E	...	...	V	V
2 Straight condensing — inlet-pressure regulation	VR	...	...	A	A
3 Non-condensing — backpressure regulation	D	...	...	VR	D
4 Non-automatic extraction	BCE	V	V	BCE	V
5 Automatic extraction or induction at B	BE	VR	...	BE	V
6 Automatic extraction or induction at B & C	BCE	VR	VR	BCE	V
7 Automatic extraction with inlet-pressure regulation	VR	VR	VR	ABC	ABC
8 Automatic extraction with backpressure regulation	BCD	VR	VR	VR	BCD
9 Inlet-pressure regulation, medium-pressure induction or extraction, backpressure regulation	VR	AD	...	VR	AD
10 Inlet-pressure regulation, medium-pressure induction or extraction	VR	AE	...	AE	V
11 Inlet-pressure regulation, medium-pressure induction or extraction, backpressure regulation	VR	ADE	...	VR	V

V — Independently variable
R — Regulated pressure
A,B,etc — Dependent on flow at A,B, etc.
E — Dependent on electrical load



This chart indicates what each type of turbine can and cannot do. Controlling one or more of the quantities which affect turbine operation requires that at least one flow quantity or load must be allowed to vary at will. For example, referring to Item 6 of the chart for a double-extraction turbine, the throttle flow is determined by the amount of steam drawn from the two extraction points and by the load being carried. Sufficient boiler capacity, then, must be available to supply this necessary throttle flow.

In Item 7, the throttle pressure is controlled independently, as well as the extraction pressures, but the load is dependent on these quantities. The minimum throttle flow must be great enough to supply the extraction quantities at all times; any excess is converted into electrical power which the system must be able to absorb.

Another condition is illustrated by Item 2. With an inlet-pressure regulator, the load is not variable at will but depends on the boilers' ability to supply steam. A much different situation is reflected in Item 5 which refers to a case of automatic extraction or induction at *B*. Any amount of steam can come in or out of the turbine at this point as symbolized by the letters *VR*, which mean that the pressure is held at a set value regardless of flow. For this case the generator load can vary as it will but the inlet flow and the exhaust flow depend on the flow at *B* and the load.

Items 9, 10 and 11 are seldom met in practice but are included for completeness. The high-pressure throttle flow is seldom regulated except as necessary to carry load or extraction steam. If inlet-pressure regulation is used, however, the connection *B* must either induct steam or extract steam to a low-pressure boiler system that is separately controlled and capable of handling these flow variations.

Air Conditioning to Meet

At Metropolitan Life's home offices, air-conditioning systems ranging from 1.5 to 1800 tons supply the requirements of

► WHEN IT WAS COMPLETED, late in 1932, Unit No. 1 of the Metropolitan Life Insurance Co's home-office buildings, in New York, was the largest entirely air-conditioned office building in the world. Since that time, Unit No. 2 has been added, and with it small air-conditioning systems to solve special problems in the older Main building and Unit 1. Ranging from 1.5 to 1800 tons and using Carrene, Freon, water vapor (steam jet), ammonia and CO_2, the air-conditioning and refrigerating installations in these buildings offer an interesting cross-section of modern practice.

The Main building, occupying a square block, is 11 stories high with a 50-story tower; it houses office space for 4500 employees and restaurants seating 1200. Unit 1 occupies half of the next block north, and provides space for 6500 employees, including restaurants with seating space for 2,500, laboratories and a gymnasium. Unit No. 2 occupies slightly more than half of the remaining space in the block; when an existing building is removed, Unit No. 3 will replace it, completing the block. Unit 2 houses 4000 employees and has restaurants with a seating capacity of 1200.

Office space and restaurant areas in Units 1 and 2 are air conditioned for summer comfort; in winter, direct radiation makes up for heat losses and humidified air slightly below room temperature is supplied by the conditioning system. Basement machinery and work spaces, where heat loss is small, are heated with warm air from a ventilating system.

In Unit 1, four centrifugal refrigerating units (rated at 325 tons each, on Carrene No. 1) supply chilled water for the two major air-conditioning systems. Replacing one of the original motors with a 400-hp 3800-rpm 125-psi 28-in.-Hg.-vacuum turbine increased tonnage to 375. The remaining three wound-rotor motors drive through 2:1 step-up gears and are manually controlled over a 5-point speed range. Automatic speed control on the turbine responds to chilled-water temperature.

Three 1800-rpm 1625-gpm motor-driven pumps (one for standby) force water through the refrigerating-unit coolers, then through three heat exchangers before entering a 12-in. all-welded piping system which rises to the main machinery floor, the 15th. Here the piping branches into four 8-in. lines, each supplying a pump at one of the four washer-fan units. These pumps force the water through the washer sprays; gravity carries the water from the washers to an 11,000-gal surge tank on the 13th floor and thence through

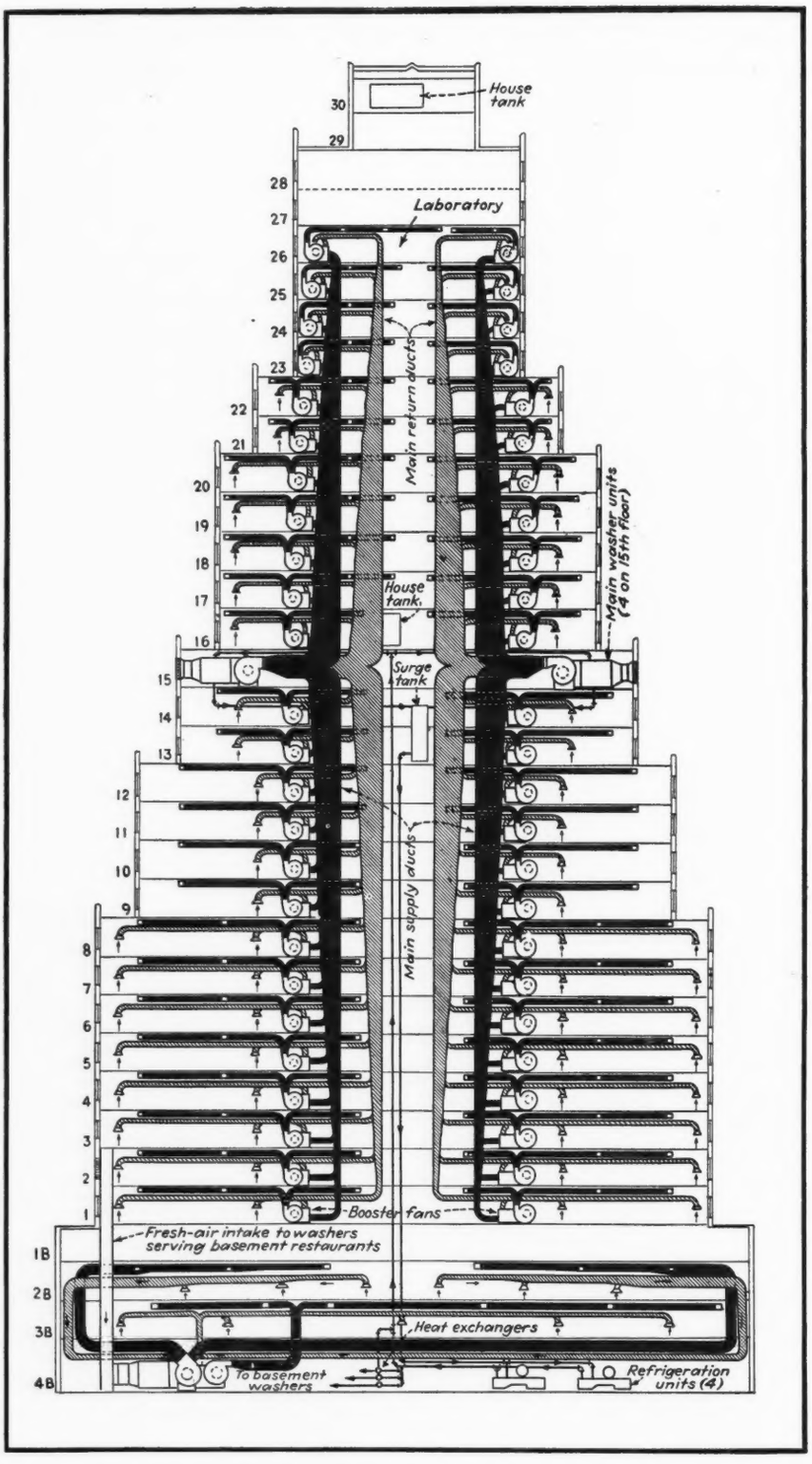


Fig. 1—The Unit 1 conditioning divides into two major systems; three washers in the basement supply restaurant spaces, four washers on the 15th floor feed down and up to supply the 26 floors of office space. Refrigeration is in the 4th basement

Office-Building Needs

extremely large entirely conditioned structures and solve the specialized problems of laboratories and telephone rooms

a 12-in. line to the chilled-water-pump suction header in the basement.

The heat exchangers chill water for three washer units that supply conditioned air to the restaurant spaces in the sub-basements, Fig. 1. Fresh air. taken in at the 1st and 2nd floors, enters the washers directly; part of the return air mixes with fresh air in passing through the washer, while the remainder by-passes the washer and mixes with the conditioned air at the fan suction. The heat exchangers permit tying the basement washers to the main chilled-water circuit without imposing high pump pressure on the washer nozzles. The basement units are under full automatic control, with a reset arrangement. The control maintains 74-F dry-bulb temperature in the conditioned spaces until outside temperature rises above 74 F, then control temperature is raised 1 F for every 4-F increase outside.

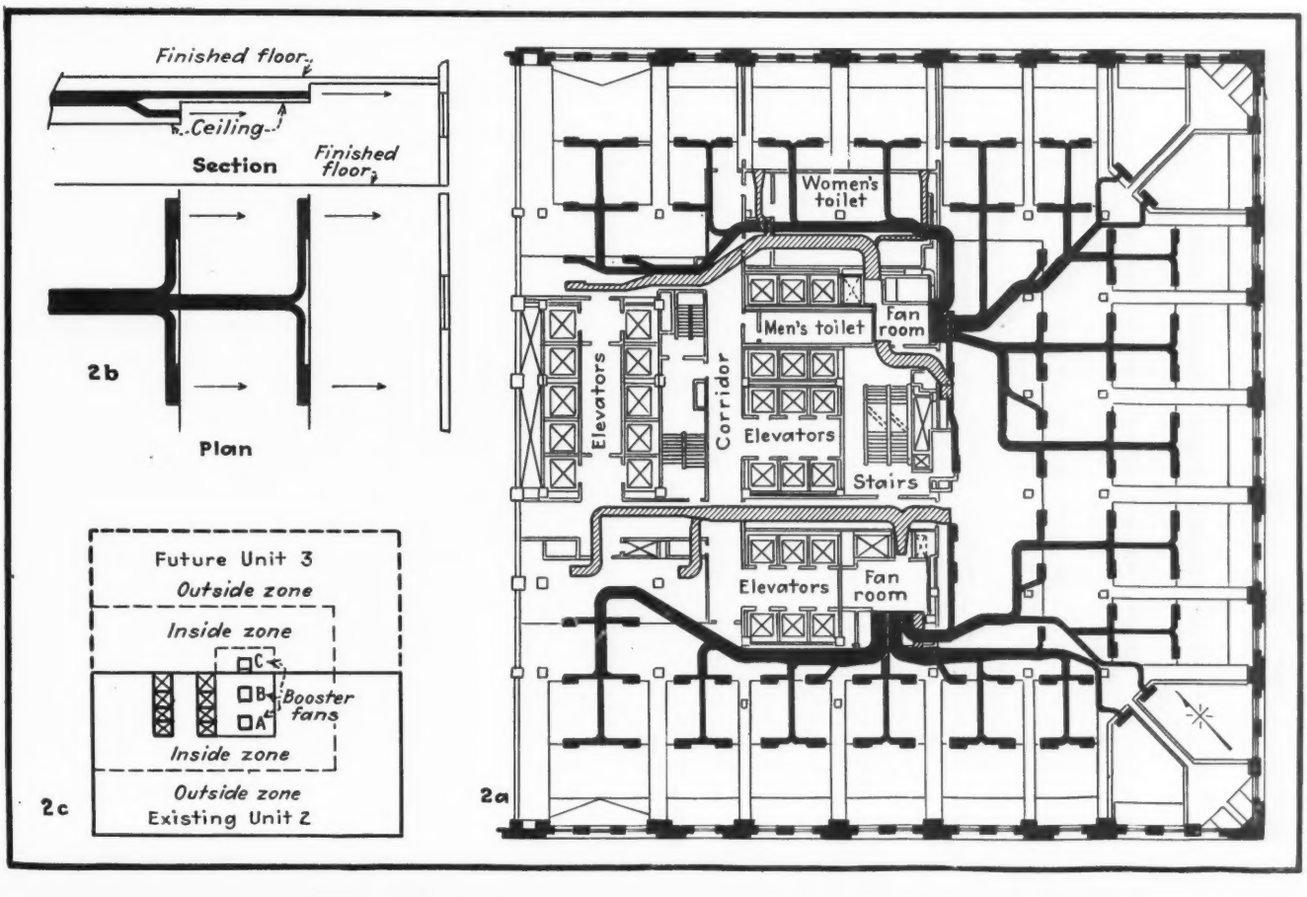
Four washer-fan units on the 15th floor supply conditioned air for the office space from the first to the 26th floor. Four trunk supply ducts, two serving the north half and two the south, connect the washers with individual booster-fan units on each floor. Four ducts, with exhaust fans on the 15th floor, handle return air. Fresh air enters through screened louvres, mixing with part of the return air in a plenum chamber before passing through washer sprays. An amount of return air roughly proportional to the fresh-air intake passes out the exhaust. Chilled water from the refrigerating units and water from the washer are blended for dewpoint control; the desired dewpoint is manually set and automatically maintained. In winter these units supply all fresh air, properly humidified.

On each floor, two booster-fan units draw air from the north and south trunk ducts and supply the respective floor areas. Each blends conditioned air with return air taken from the branch duct leading back to the main return duct, Fig. 1. A fixed damper insures a minimum of about 20% conditioned air. The air passes through dry filters and then out into the office space. Fig. 2 shows a typical floor with ducts and outlets, and also illustrates the method of introducing conditioned air through ceiling grilles used in Unit 1. In winter, small booster coils temper the mixture of humidified and return air to 70 F. Summer operation is under control of thermostats in the return ducts; in winter, thermostats in supply ducts control.

Steam radiation along the exterior walls takes care of heat losses. Pressure on the system varies from slightly less than 1 psi to 10-15-in. vacuum, depending on outside weather conditions. Each radiator is equipped with an air-actuated valve; one thermostat controls three or four radiators. For night and week-end operation at reduced temperatures, control-air pressure is increased from 13 to 17 lb.

To solve special problems, three small air-conditioning systems have been installed in Unit 1. The biochemical laboratory on the 26th floor requires conditioning on 24-hr 7-day basis and because of the work's nature it is advisable to isolate this space. A 6-ton steam-jet unit, installed in a wall cabinet, supplies a ceiling unit conditioner in the duct system feeding the lab rooms. In the standardization laboratory, a 1.5-ton self-contained Freon unit maintains exacting conditions for which it would be inconvenient to use the main building system. To keep telephone

Fig. 2a—Booster-fan units and duct layout for a typical floor in Unit 1. Fig. 2b—Ducts concealed above ceiling supply grilles located in vertical "steps" (Unit 1). Inspirating diffusers are used in Unit 2. Fig. 2c—Each floor in Unit 2 is divided into inside and outside zones with a booster fan to supply each. When Unit 3 is added, another fan *C* will handle the outside zone and existing fan *B* will take care of both inside zones. The fan room will be extended.



switchboard and dial equipment dust-free and at the proper humidity, still another small system was installed on the 15th floor. This draws makeup from a conditioned-air duct and blends it with return air. The mixture passes through dry filters and an electrostatic precipitator.

The main system for Unit 2 differs in detail from that in Unit 1, embodying many improvements. Three 600-ton centrifugal units, using Carrene No. 2, provide capacity for this building and the future Unit 3. These machines connect through a chilled-water tie line to the refrigeration system in Unit 1 so that under light load either group can handle both buildings. The Unit 2 compressors were driven by 4200-rpm 700-hp turbines automatically controlled according to chilled-water temperature.

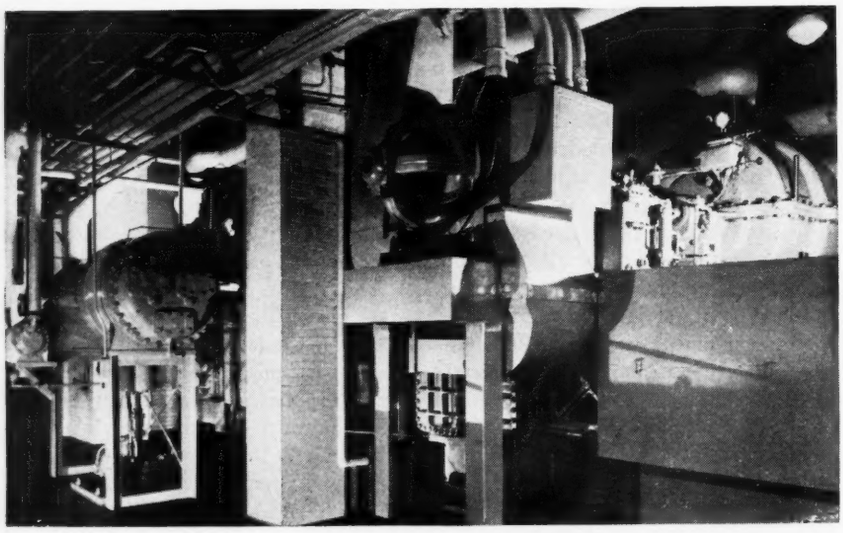


Fig. 3—Drive end of centrifugal refrigeration compressors in Unit 1

Cooling water for both steam and refrigeration condensers in Unit 2 comes from a closed circuit with four 1200-gpm cooling towers on the roof. Cooled water goes first to the refrigeration and then to the steam condensers.

Chilled water from Unit 2 compressors goes first through heat exchangers and then to the main washers on the upper floors. However, experience with Unit 1 showed the desirability of greater flexibility and a more subdivided system. In Unit 2 the system consists of four parts: (1) a single washer in the 1st basement supplying restaurant space, (2) two washers on the 2nd floor supplying the Inquiry Bureau on the main floor and the 2nd, 3rd, and 4th floors and mezzanines, (3) two washer units on the 15th floor supplying from that floor down to the 5th, and (4) one washer on the 30th floor supplying floors 30 and 16. This arrangement substitutes a down-feed system, compared with the down and up-feed of Unit 1 and also permits independent operation for parts of the building where conditions differ.

A pump room in Unit 2 houses four 1600-gpm motor-driven chilled-water pumps which supply the upper floors; two relay pumps lift the water from the 15th-floor washer to the unit on the 30th floor. Five heat exchangers in the pump room chill water for the basement and 2nd-floor washers. The pump room also houses four 2400-gpm cooling-tower pumps. This equipment provides capacity for Unit 3.

The basement washer unit consists of a single fan and washer with return- and fresh-air ducts arranged in a bypass to mix the two for dewpoint control. Electrostatic air cleaners remove smoke and other extremely small impurities from both incoming fresh air and return air. This conditioner is automatically controlled with a reset device for adjusting room temperature to outside conditions. The 2nd-floor units resemble the basement equipment but have dry filters in place of the electrostatic air cleaners. Aside from the fact that two are on the 15th and two on the 30th floor, the main washers and fans for Unit 2 are similar to those of Unit 1 but are equipped with dry filters.

Experience indicated that the booster-fan arrangement in Unit 1 could be improved by further zoning. In Unit 2, each floor is divided into two zones, one along the outside walls and one at the center, Fig. 2. Each is served by a separate booster fan; when Unit 3 is built another fan will be added to supply the outside zone and the existing fan will handle the inside zone of both buildings. Operation of the individual units resembles that of Unit 1 boosters except that thermostats are located in the conditioned spaces.

Units 1 and 2 represent practice common when a new structure is to be entirely air conditioned. The installations in the Main building show what can be done to condition parts of an existing structure. Two 10-ton Freon condensing units connect to a cooler and fan on the 3rd floor which supply offices on the 2nd floor. A 15-ton steam-jet unit conditions the medical division on the 3rd floor. A complete "packaged" system, with evaporative condenser, direct-expansion coils, winter humidifying sprays and provision for the addition of fresh air, conditions a dining room.

Both the main building and Unit 1 house refrigerating plants for general service. In the main building this consists of a 40-ton motor-driven vertical compressor, a 20-ton horizontal steam-driven unit and a 3-ton motor-driven vertical machine, all operating on ammonia. Brine coils, supplied from this system and installed in existing ventilating ducts, cool a few spaces throughout the building. The Unit 1 CO_2 system comprises three 40-ton and one 7-ton vertical units, all motor driven.

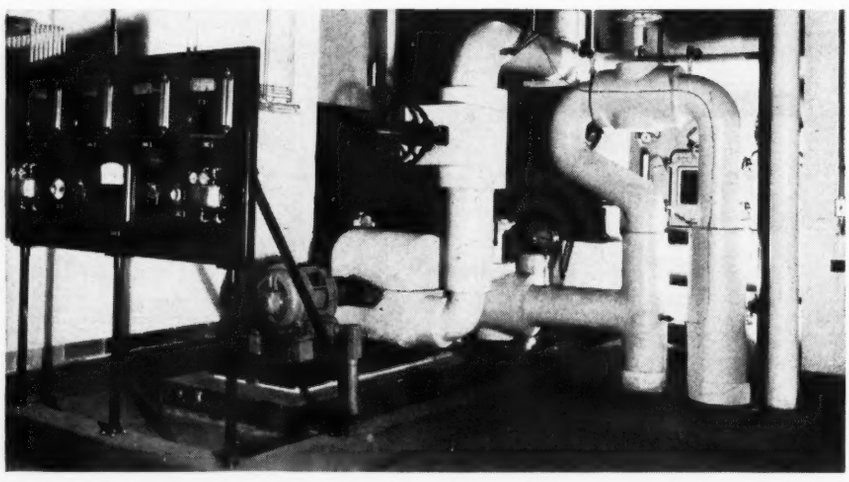
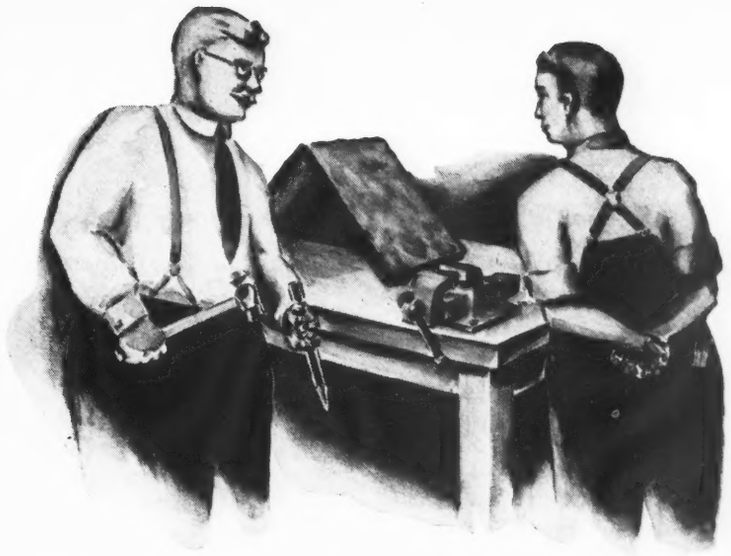


Fig. 4—Washer on 30th floor of Unit 2; pump circulates water through washer nozzles; mixing washer water and chilled water controls dewpoint

The Old Chief

XVII

Learning the Trade



Another in the series by William Doran, chief engineer, Essex County Sanatorium, Windsor, Ontario. Writing of the past, he has captured much of the human side of engineering

► METAL CASTINGS, among many other things, are certainly not what they used to be. The sand-blasted perfectly shaped things we see on the bench today are only very distantly related to the rough, lumpy, ill-sized pieces of metal we once received from the molders without so much as a word of apology.

Sometimes the castings would be as hard as flint; other times they would chip like ice. Another condition that made for hard chipping was known to us as "chough" or tough. I remember the surplus metal that had to be removed from every casting that we received, because the Old Chief was very fussy about what he called "a tradesmanlike finish."

One day about the time when I was receiving as my weekly wage the princely sum of two dollars, I was chipping castings in a very gingerly manner. Out of respect for my sore knuckles, I was holding the hammer very close to the head. The Old Chief, evidently noticing my lack of progress, asked my leave to show me how to chip.

Holding the hammer as I had been doing and imitating my manner of striking, he said, "Listen, son, a fellow chipping like this might be worth about 50¢ a week." Then moving his hand three inches down the handle and slightly increasing his swing, he said, "This kind of chipping might be worth, say, a dollar a week." Then taking the hammer by the end of the shaft and swinging it from behind his head with a merry clip, he said, "Why, I would say that a fellow chipping like this might be worth two dollars a week."

On another occasion he asked me to remember the rule: "Never *chip* if you can *saw*, never *file* if you can *chip*, never *scrape* if you can *file*." On still another occasion he gave us a lesson in the deportment of a tradesman. "Never *kneel* if you can *stand*. Never *sit* if you can *kneel*. Never *lean* on the bench, and never under any circumstances *walk slowly*."

Blacksmithing

That lesson from the Old Chief must have improved my skill, because a few months later, when they needed an extra striker in the blacksmith's shop, I was elected to swing a 14-lb sledge. After the first day I was able to swing with the best of them and I was very proud of my ability to graduate the "punch" of my sledge to the exact requirements of the blacksmith.

I worked with the millwrights for some time setting up some new machines in the factory and when they were ready and "grouted in," the Old Chief sent me to assist old Ted the belt man. Ted was a nervous man and the Old Chief warned me to be very respectful to him and to do what I could to clean up his shop. Ted had a leather apron and wore glasses which he invariably looked over or under. He was a highly skilled craftsman and was recognized as such. He always referred to himself as a "power-transmission man" and never as a belt man.

On my first day with him, he brought forth from a cupboard a number of horrible examples of "botched" belt repairs, which were done by someone while Ted was off duty. This I interpreted as a warning never to attempt repairs without consulting him. I learned many things from Ted and never did a youth have a more exacting tutor. He taught me the trick of making "cup leathers" to an exactness not known outside the toolroom.

His method of figuring the horsepower of a belt was by first finding the belt speed. This he did by multiplying the diameter of the pulley in inches by 3.14, again multiplying by the number of revolutions per minute of the pulley and dividing the total by twelve. He would then consult a chart which gave the horse power for various widths of belts of single, double or triple ply, at any belt speed. His ability as a belt-repair man was known all over the district and many of the other plants invoked his aid when in trouble.

But the perfect workman had one big fault. He kept the most untidy, disordered, fire-trap shop that you ever saw. Belt stretchers of all sizes lay here, there and everywhere; wooden split pulleys were in a jumble in one corner; only the bench was kept reasonably clean. He resented all efforts to change this condition and refused to sanction throwing out even the most worn piece of leather.

Individual Drives

The sad time came when his shop was not only cleaned up, but turned into a stockroom. The line shafting had gone and the new belt fasteners could be put on by any "duffer." Old Ted became an oiler until he was pensioned off. A traveling man ran across him at the Chicago Worlds Fair, stopped him and asked if he was the belt man that used to work at the old plant. "Why no," he replied, "I was the power-transmission man there!"

Diesels for Small-Town America

Experience at Hallettsville, Texas, shows that diesels, properly applied, can bring operating economy to the small municipal

▶ HALLETTSVILLE, TEXAS, is a notable example of a small community that has made a success of its diesel plant with resulting benefits to the consumer-citizen. In ten years the town has built up a 980-hp plant, culminating this development in 1936 with a 500-hp unit. Over the same period the town has cut domestic rates for electricity 65% and the diesel plant has returned to the community $180,000 in cash and free services.

Hallettsville constructed its municipal water works and power plant in 1890 with a small steam prime mover. In 1916, a single-cylinder 75-hp Standard oil engine was added but was abandoner four years later. By 1922 renovation of the plant was necessary and a high-speed steam engine was installed. This served until load growth outstripped its capacity.

In 1930, Hallettsville put in service the first two engines of its present modern diesel plant. These units were identical 240-hp 4-cyl 14 x 17-in 2-stroke-cycle mechanical-injection engines, driving 257-rpm direct-connected 160-kw alternators and exciters. Decreases in operating cost brought increase in electricity consumption and in 1936 it was decided to go on an all-diesel basis, doubling the plant capacity. The town officials purchased a 5-cyl 12x15-in. 400-rpm 500-hp engine direct-connected to a 343-kw alternator. A 15-hp 10-kw motor-generator set provided excitation with a small emergency exciter belted to the diesel.

In the ten years since installation of the first diesels, peak load has grown from 100 kw to 340 kw in 1940 and daily kwhr production from about 1500 to 3000. In 1930 the average rate paid by domestic consumers was $.10 per kwhr; by 1940 this had dropped to $.035. Each year the power plant makes a cash contribution of $10,000 to the town treasury, in addition to supplying free current to the water department, public buildings, street lighting, Christmas lighting displays, fairs, and the city recreation hall. Diesel earnings have helped to provide paved streets, sewers, water mains, parks and the Hallettsville community recreation hall.

These achievements were all accomplished during the period of load expansion. This town of about 1500 population began ten years ago with an exceedingly small load and even today production is not large. This means that fixed charges such as labor take a large share of the total operating cost. Actually, labor accounts for more than 50% of production cost. Although load conditions are such that engines cannot be run at maximum efficiency, Hallettsville produced power in 1940 for a total operating cost of 8.8 mills per kwhr for labor, fuel, lubricating oil, maintenance, and repairs. With depreciation included, the cost comes to 11 mills per kwhr.

Table I gives the itemized cost report for 1940. Table II breaks this down into monthly figures for the same year, showing kwhr generated, fuel and lubricating oil consumed and kwhr per gal of fuel. To achieve these economies in spite of unfavorable load conditions indicates sound design and careful operation. In the following description of the plant, major attention centers on the newest and largest unit, the 500-hp engine.

Every element in the plant's design serves to produce either ease of opera-

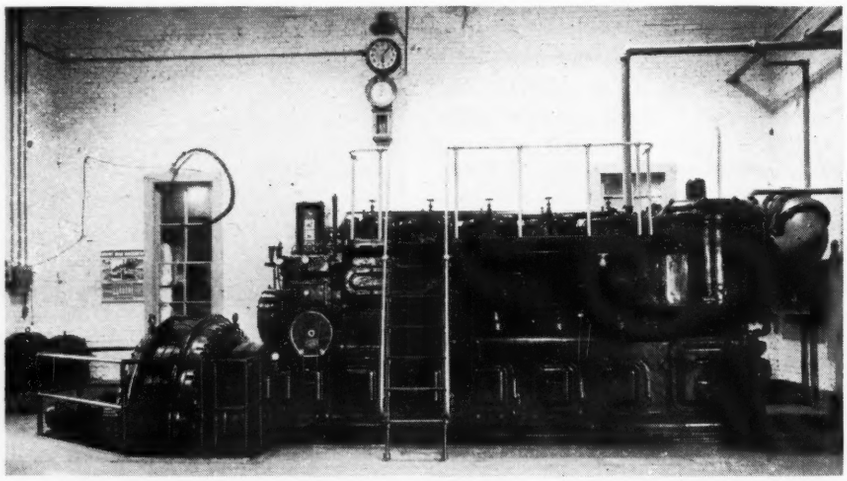


Fig. 1—Latest addition to the plant is this 500-hp diesel. Motor-generator set, left, serves for excitation. A small exciter is belted to the engine for emergencies

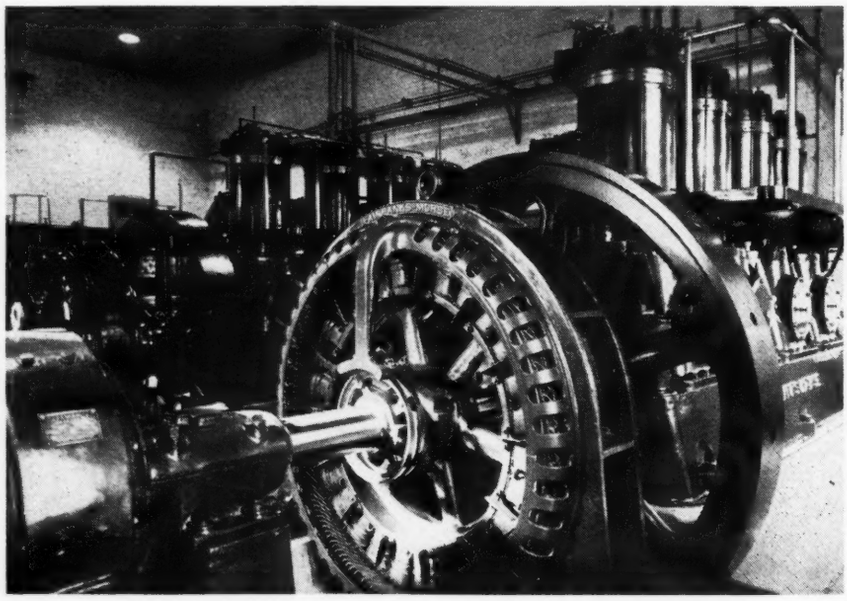


Fig. 2—Hallettsville's first diesels were these two 240-hp 4-cyl 14x17-in. 2-stroke-cycle mechanical-injection units installed in 1930 and still in service

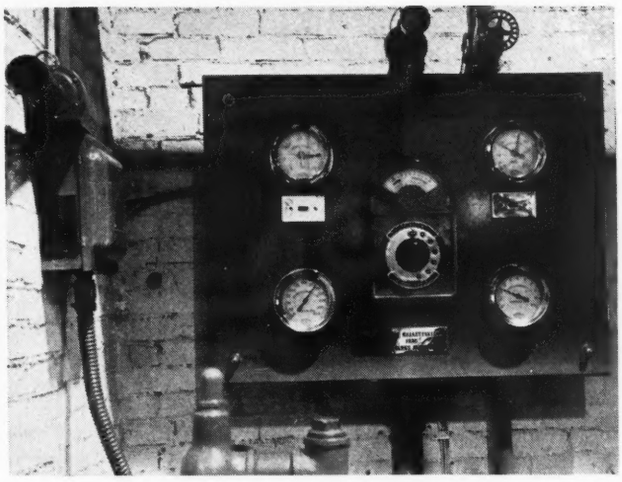


Fig. 3—This alarm system, with multi-point exhaust pyrometer, protects the new unit's cooling-water and lubrication systems

tion, economy, or engine protection. Lubricating oil is conserved, as consumption figures indicate, but the engines always receive an adequate supply of clean oil. Mechanical lubricators supply the cylinders; oil picked up by the wiper rings drains to a tank, goes through a centrifuge and then back to the crankcase. An engine-driven gear pump circulates oil to the bearings, with a filter and cooler as integral parts of the circuit. This same lubricating oil is forced up into the pistons to cool the crowns. Periodic draining and treatment in an activated-clay purifier removes impurities from the lube oil. No oil is discarded.

TABLE I

Cost Report — 1940

Labor	$4580
Fuel	3633
Lube oil	598
Maintenance	245
Depreciation	2500
Total	$11,556

All fuel is purchased on specification (Table III) and is filtered and metered. There are two fuel-oil storage tanks, a 10,000-gal tank near the railroad three-quarters of a mile from the plant and a 17,000-gal tank at the plant. A motor-driven centrifugal pump unloads fuel from tank cars into either of the tanks or transfers oil through the 2-in. line connecting the tanks. A positive-displacement motor-driven pump transfers oil to the three day tanks (two 330- and one 625-gal) buried in concrete pits. Engine-driven pumps pick up the fuel from the day tanks and supply it to the individual injection pumps. In the case of the 500-hp unit, the engine supply pump handles enough fuel to keep a 30-gal overhead tank full. If the pump should fail, oil would flow from this tank by gravity to the injection pump and a float in the tank would sound an alarm. Thus the engine would continue to run while the operator corrected the trouble. A relay governor regulates quantity of oil injected to suit load conditions. Fuel is filtered and metered between the storage and day tanks and filtered again after leaving the engine supply pump.

TABLE II

Monthly Operating Figures — 1940

Month	Production, kwhr	Fuel, gal.	Lube oil gal.	Kwhr per gal.
January	84,950	7848	184.5	10.8
February	75,800	7072	77.5	10.7
March	76,750	7212	82.5	10.6
April	72,550	6872	85.5	10.6
May	79,400	7498	87.5	10.6
June	81,350	7599	103.5	10.7
July	87,800	8383	68.5	10.5
August	90,850	8508	142.5	10.7
September	84,300	8408	105	10.0
October	87,000	8072	127	10.8
November	94,800	9053	136	10.5
December	105,250	9841	130.5	10.7
Total	1,020,800	96,366	1,330.5	10.6

A zeolite softener treats the cooling water before it enters the engine jackets. Originally an open system with an atmospheric cooling tower was used. Two motor-driven centrifugal pumps circulated the water. These pumps are still used to handle the jacket water but the cooling system is now closed, with an evaporative condenser.

(*Continued on page* 132)

TABLE III

Fuel-Oil Specification

Gravity, deg. Baume	35.4
Flash point, F	164
Color, ASTM	Dk 1
Sulphur, %	0.10
Pour point, F	20
Viscosity (100 F), ssu	38
Viscosity (70 F), ssu	43
Corrosion at 212 F	OK
Aniline No.	161
Cetane No.	59
Conradson Carbon Residue, %	Trace
Initial boiling point, F	370
10%	477
50%	539
90%	627
End point, F	698
Recovery, %	98

Principal Power Equipment

Hallettsville, Texas

Generating Equipment:

Engines, 3, two-cycle, mechanical-injection...Fairbanks, Morse & Co
One 500-hp 5-cyl 12x15-in. 400-rpm pump-scavenging unit and two 240-hp 4-cyl 14x17-in. 257-rpm units
Generators, 3, direct-connected.....Fairbanks, Morse & Co
One 343-kw and two 160-kw 2400-volt 3-phase 60-cycle alternators
Motor-generator, for excitation.....Fairbanks, Morse & Co
Governors.....Woodward Governor Co
Exhaust silencers.....Maxim Silencer Co
Air filters.....American Air Filter Co
Pyrometers.....Brown Instrument Co
Alarm panel.....Fairbanks, Morse & Co
Switchboard, voltage regulator.....General Electric Co

Fuel System:

Pumps, unloading, transfer, injection.....Fairbanks, Morse & Co
Filters.....W W Nugent & Co, Inc
Meters.....Neptune Meter Co

Lubricating System:

Lubricating oils..The Texas Co (Ursa), Magnolia Petroleum Co (DTE)
Oil cooler.....Schutte & Koerting Co
Filters.....Purolator Products Co, Schutte & Koerting Co
Oil purifier.....Youngstown Miller Co, Inc
Centrifuge.....Sharples Corp
Mechanical Lubricators.....Madison-Kipp Corp

Cooling-Water System:

Evaporative cooler.....Fairbanks, Morse & Co
Jacket-water pumps.....Fairbanks, Morse & Co
Zeolite softener.....Rathbun Co

"99 44/100%" Dry Air for Circuit Breakers

Successful and efficient operation of high-voltage air-blast breakers depends on moisture-free compressed air; Carl Thumim, Switchgear Div, General Electric Co, describes several ways of dehydrating air and providing a leakproof system

▶ HIGH-VOLTAGE, HIGH-POWER circuit breakers recently developed use compressed air for arc interruption as well as for closing and opening the contacts. Because dielectric strength of air improves as pressure is increased, working pressures for various ratings of breakers must be selected to give the best combination for arc interruption, economy of air usage, availability of apparatus and standardization. Tests have demonstrated that for breakers up to 138 kv three general pressure levels are desirable: 150, 250 and 350 psi. The problem then resolves itself into supplying a satisfactory quantity and quality of air at these pressures.

To meet the severe requirements of this service, not only must enough air be delivered at the chosen pressure but sufficient compressed air must be stored for comparatively long periods to provide for circuit-breaker operation in case of breakdown. The system must be sectionalized so that disruption of any part will not affect the normal operation of the remainder.

Tests have shown that globe and check valves equipped with non-metallic disks are suitable for use at pressures up to 400 psi. Above this pressure, valves with stainless-steel seat parts in a specially designed construction give perfect tightness when tested with soap solution.

A problem of equal importance is the maintenance of service in the presence of moisture. Economic reasons limit the universal use of corrosion-resisting materials especially where large parts or long runs of pipe are concerned. Moisture also has a deteriorating effect on some of the non-metallic materials used both in the compressor system and the circuit breaker, and does not improve the high-voltage creepage value of the interior insulation.

Freezing because of low external temperatures or of expansion through valves and orifices can result in a partial or complete cutoff of air, rendering the circuit breaker inoperative. Thermostatically controlled heating units at vulnerable points will remedy this; however, the number required may be too great for practical purposes. The best way to avoid these troubles is to reduce the moisture content of the air to a point where the gross amount is insufficient to cause much deterioration or blockage by freezing. The dew point of the free air should be materially below any temperatures to be encountered in practice.

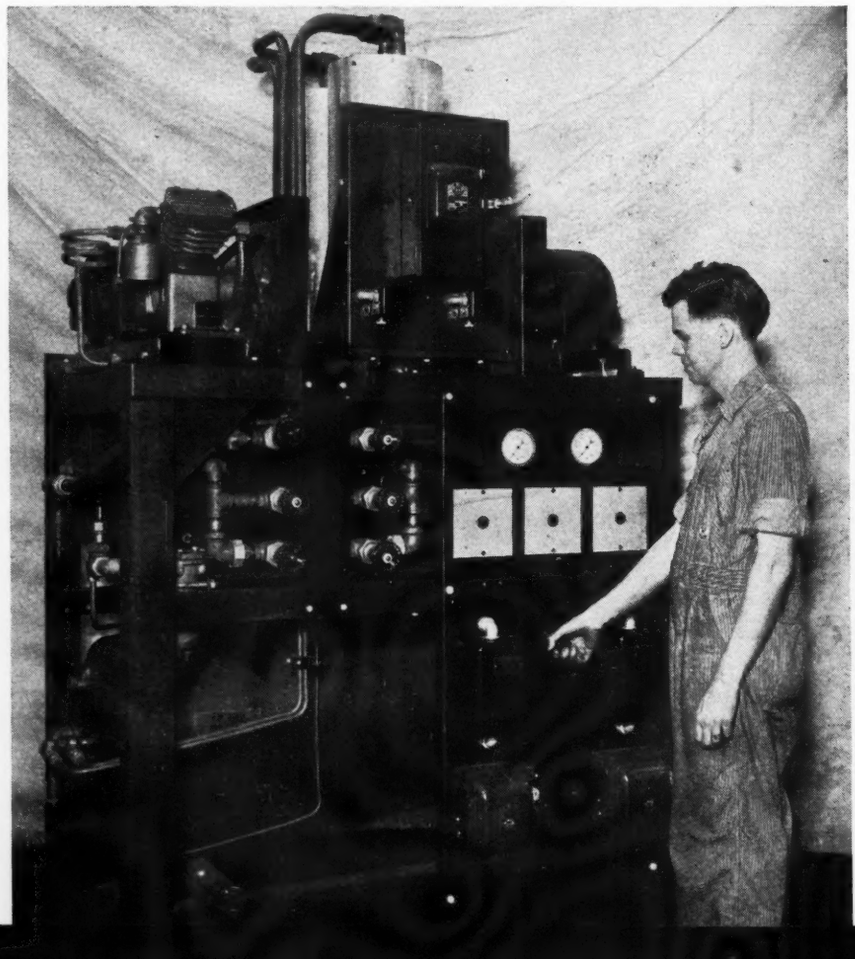
There are several practical methods for removing excess moisture from air: chemical drying or absorption, refrigeration, compression and expansion, and combinations of the three.

The chemical drying cycle consists of compressing the air to working pressure in the main storage reservoir, then passing it through a chamber containing a dehydrating material, such as activated alumina or silica jel, on the way to the individual circuit-breaker tanks. The amount of water removed depends on the air flow and quantity and condition of the active material.

By proper proportioning it is possible to obtain extremely low dewpoints. As the saturation point is approached, the absorbing material may be reactivated by drying in an oven or by passing large volumes of heated air through it until the exit temperature equals the entering-air temperature. To avoid interruption of air supply during the reactivating process, a duplicate dehydrating system is usually used so that one will pass air while the other is being dried out.

In the refrigeration drying cycle, air is compressed to working pressure, then passed through coils cooled by any suitable commercial refrigerating system. Precipitated water is blown off. Referring to Fig. 4, if air at a working

Fig. 1—Semi-automatic compressor equipment using the compression-expansion cycle followed by chemical air dehydration provides moisture-free air for breakers



pressure of 250 psi has a temperature of 35 F its moisture content will be 0.019 lb per cu ft, and the temperature at release must drop to −25 F before ice would be precipitated, as indicated by the dotted lines *A*, *B* and *C*. For indoor installations the temperature is certain to be higher than the 35-F dewpoint of the air, which would eliminate possibility of precipitating moisture in the pressure system.

In case it is desirable to use this cycle for temperatures lower than 32 F, duplicate coolers with passages designed to avoid clogging with precipitated ice are necessary. Where a duplicate cooling arrangement is unnecessary, the air portion of the system is simple and reliability of the cycle hinges upon the dependability of the refrigerating end.

From Fig. 4, it is evident that at any temperature, the moisture content falls as the pressure rises. It is practical then to use a compression-expansion cycle in which the air is compressed to a point where the dewpoint is lower than the temperatures to be met. Excess moisture is drained off and the air is reduced to working pressure. For example, if air is to be used at 350 psi, compressing it to 1000 psi, cooling to 75 F, draining the precipitated water and reducing to 350 psi will permit approximately a 30-F drop at working pressure and almost a 100-F drop at release to the atmosphere before further precipitation occurs, as indicated by dotted lines *D*, *E* and *C*.

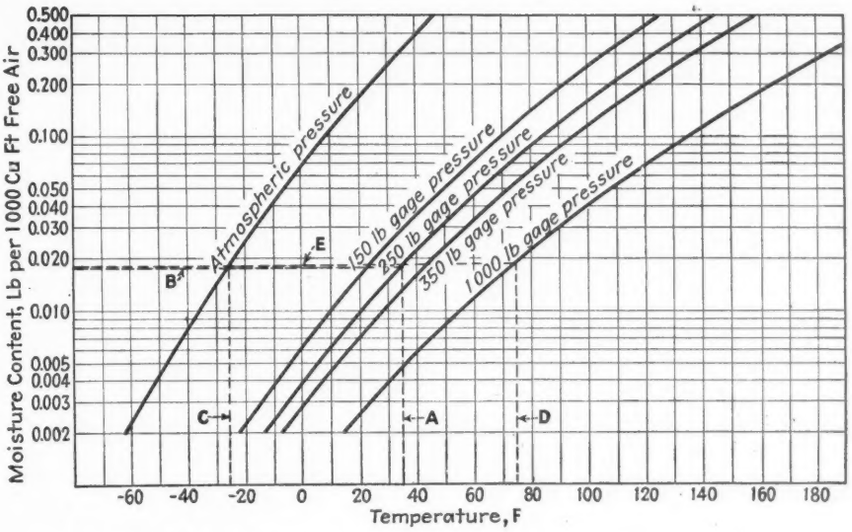


Fig. 4—Saturation of air takes place at a lower moisture content as the pressure is increased while the temperature is held constant. Excess moisture above 100% humidity is precipitated and can be removed from the system

Combined Cycles

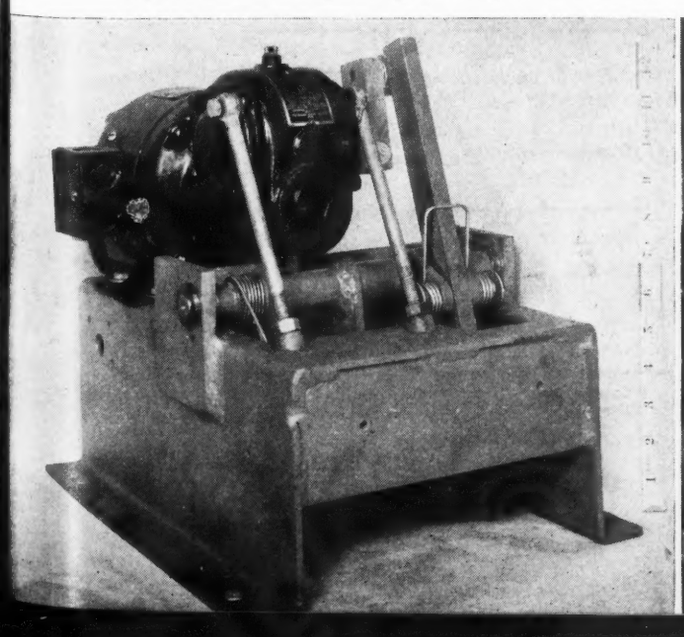
The cycles enumerated may be combined in several ways to extract more moisture from the air and make it safe to use at lower temperatures. One successful arrangement involves compressing air to higher than working pressure, passing it through refrigerating coils, draining off precipitation and reducing it to the normal working pressure.

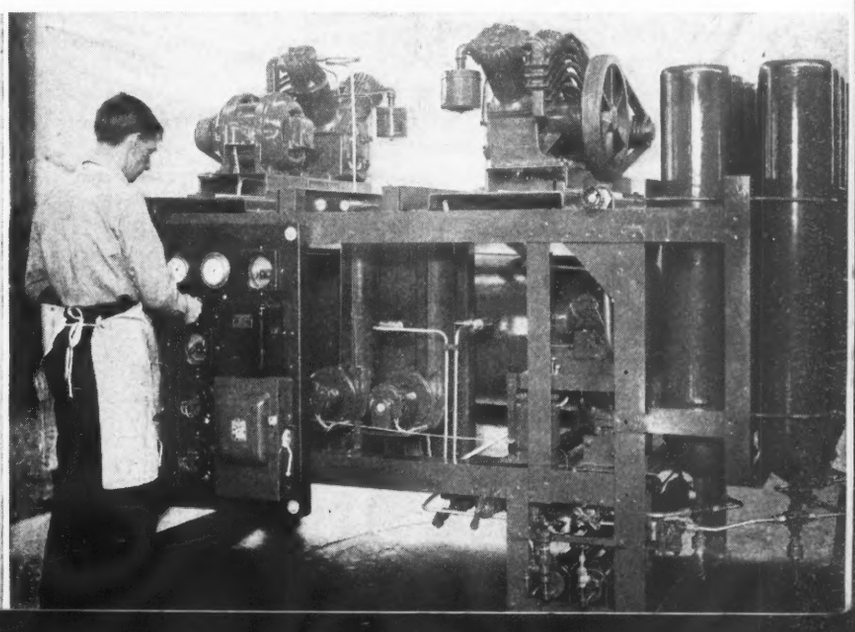
Another combination offers the advantages of the chemical-absorption method with the least amount of material and long periods between successive reactivations. The steps are: compress the air to higher than working pressure, drain off precipitation, reduce the air to working pressure and pass it through an absorption unit.

Lack of complication, increased storage capacity of the high-pressure stage, ease of obtaining continuous operation, simplicity of automatic control, and adequacy of moisture removal of the 250- and 350-psi compression-expansion system make it highly satisfactory for circuit-breaker operation. Fig. 5 is the schematic diagram of this apparatus. Where only one set of equipment is provided in a circuit-breaker installation, duplicate compressors, one as a standby, should be used. Where the installation is large enough to call for several sets of equipment, each set need have only a single compressor with pipe connections tying all compressor units together for use in an emergency.

Construction details are important and differ materially from those of standard commercial apparatus. The check valve of the soft-seat dashpot should be located at the receiver and should not be heated higher than 130 F by the air leaving the aftercooler. Operation of the compressor motor is automatically governed by a pressure switch developed to give the reliability, accuracy, small differential, and long life needed for circuit breakers. The air receivers are built for pressures 50 psi in excess of the working pressure to simplify the problem of keeping the safety valve tight. The air flows from the high-pressure receiver, through a filter, regulating valve, and check valve into the low-pressure receiver. External sumps and valves are provided to permit easy servicing. For the dead-end service required, an electrically operated valve fitted with bubble-tight seats takes the place of a standard reducing valve.

Fig. 2—(left)—Motor-operated regulating valve with a solenoid-controlled trip-free linkage to provide for instantaneous shut off.
Fig. 3—For the 1000-psi compression systems it is more convenient to use standard cylinders in place of a conventional air receiver





Operation of this valve is controlled by two pressure switches in series, one in the high-pressure receiver to permit flow only after a minimum high pressure is available, and the other in the low-pressure receiver to limit the maximum pressure inside. This assures a minimum amount of moisture in the low-pressure system by eliminating the possibility of raising the pressure simultaneously in the whole installation without going through the compression-expansion cycle.

Where lower dewpoints are required for outdoor service, the air is compressed to 1000 psi and, after precipitation of moisture, reduced to the working pressure. In Fig. 4, at 80 F and 1000 psi, the moisture content is 0.023 lb per 1000 cu ft of free air. If the working pressure is 250 psi no moisture would deposit until the temperature had fallen to 40 F, and at exhaust the precipitation point would be −22 F.

The connection diagram is similar to that used on the lower-pressure systems, Fig. 5, except that a strainer precedes the regulating valve and a filter follows on the low-pressure side. The valves have metal seats of special stainless-steel bubble-tight construction with the exception of the regulating valve, which is a balanced, packed-plunger motor-operated unit with pressure-switch control. No commercial valve having the proper characteristics being available, the valve shown in Fig. 2 was developed. The motor opens the valve through a reaction-type trip-free linkage, the anchor point of which is held by an electro-magnet energized in parallel with the motor. At any time after the valve has begun to open, the pressure switch may break the circuit, the magnetic latch will release, the motor will be disconnected by the collapse of the trip-free linkage, and the valve will close instantly under the closing springs.

Equipment of this type is shown in Fig. 3. In place of a conventoinal receiver, it has been found convenient to use standard cylinders which are approved under the ASME code for unfired pressure vessels for use at the required high pressure in a permanent installation.

Distribution System

After the air has been made available in proper quantity and quality there remains the problem of obtaining safe distribution to the circuit-breaker receivers. Most reliable is a closed-loop system such as shown in Fig. 6. This provides two paths for the air to follow. To assure continuity of supply, any breakdown must be immediately and automatically isolated by sectionalizing check valves. These are constructed to permit ordinary flow of air in either direction. When the flow becomes excessive, because of a break in the line, increase in pressure differential overbalances thrust of a calibrated spring and flow in that direction is stopped. Metal-to-metal seats are provided so that a slight leak persists. Adjacent to each sectionalizing valve is an ordinary shutoff valve. After repairs are effected, closing this valve for a short interval causes the sectionalizing valve to open. Then slow opening of the shutoff valve will restore air flow.

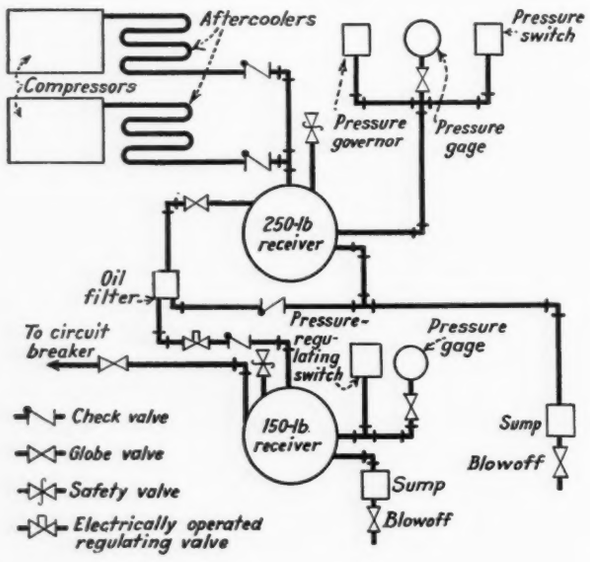
A similar situation exists where the individual circuit-breaker receiver connects to the air-distribution system. Here flow in only one direction, toward the circuit breaker, is required and the construction is identical with that of the sectionalizing valve. Return flow is completely shut off by a non-metallic seat. Thus a breakdown at the circuit breaker will isolate it from the air-distribution system so that other units will not be affected. After repairs, air flow may be restored by closing and opening an adjacent shutoff valve.

As in conventional systems, pipe runs should have a sufficient slope to permit moisture to flow to sumps of generous proportions where it may be blown off. The slope should always be away from the circuit breaker.

Because of the automatic nature of both compressor and distribution system the arrangement and construction of the parts is such as to reduce the amount of maintenance to a minimum. Valves have been chosen to give satisfactory performance over several hundred thousand operations, which in most cases would be many years service. After the initial charging of the system, moisture should be drained at all sumps and all strainers should be cleaned to eliminate solid matter loosened during assembly. It should not be necessary to examine these points more than once every six months, although in humid climates or where breaker operation is quite frequent the moisture may have to be blown off more often.

While reliability has been and always will be the main criterion in judging air supply for circuit breakers, by the proper choice of dehydrating cycle, materials and apparatus, other beneficial qualities are obtained. Automatic operation, for example, eliminates frequent and possibly inexpert handling. Filters and strainers preserve valve seats and reduce maintenance. Generally, the quality of service rendered by these systems must be superior to that expected from the standard compressor units.

Fig. 5 (left)—Equipment required for the compression-expansion cycle. High-pressure receiver increases reserve storage capacity.
Fig. 6—Distribution-system reliability is increased by using the ring system of piping equipped with automatic check valves



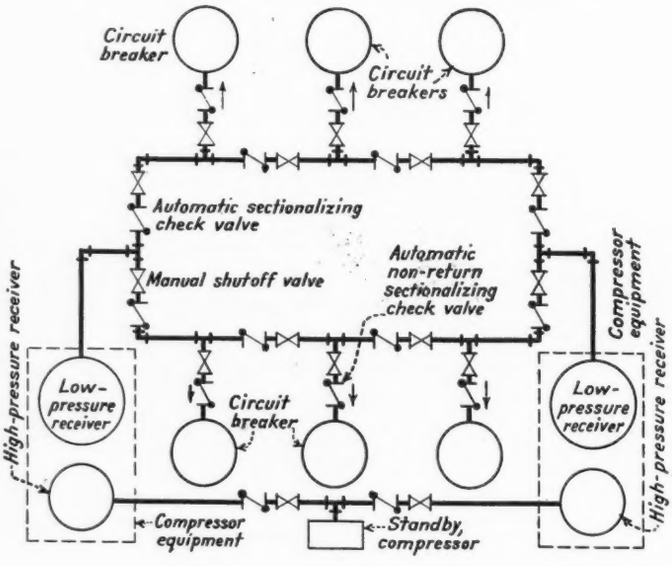


Fig. 1—Upper run of pivoted-bucket coal conveyor over boiler room bunker has a capacity of 60 tons per hr at 50 ft per min.

900-ft Conveyor Handles Three Coal-Moving Jobs

W G Hudson, Link-Belt Co, describes the Central Park Ave pumping plant, where a pivoted-bucket conveyor circling 250-ft storage bins and 117-ft boiler-room bunker carries coal from car to bunker or storage and from storage to bunker, and solves coal overheating problems

▶ The Central Park Ave municipal pumping station, Chicago, Ill., houses one 80,000,000- and three 60,000,000-gpd steam-turbine-driven pumps. Water for these pumps flows by gravity through a 16-ft tunnel, in solid rock, which runs 185 to 200 ft below ground level and extends to the intake near the bottom of Lake Michigan several miles offshore. Five stoker-fired boilers, each having 5000 sq ft of water-heating surface, and operating at 200 psi and 500 F supply steam to the turbines.

In this plant, designed by the City's Bureau of Engineering, Public Works Dept, W W DeBerard, city engineer, every precaution has been taken to insure a dependable fuel supply, because operation of the plant must never stop. Because the station is in a residential district a large ground coal-storage could not be provided. This problem was solved by a concrete structure 26 ft wide by 246 ft long and 70 ft high, Fig. 2, which is divided transversely by vertical partition walls into ten bins 23 ft square, Fig. 4, with hopper bottoms, Fig. 5.

Coal is delivered by rail from various mines to a 14x23-ft track hopper, with a grid which culls out lumps of excessive size. Beneath the hopper a 30-in. apron feeder, Fig. 3, driven at 12 fpm by a 5-hp high-torque, totally inclosed squirrel-cage motor, discharges to a pivoted-bucket Peck carrier conveyor through a crusher.

Normally stoker coal that requires no crushing is available. The crusher, which has two 26x30-in. rolls with manganese-steel crushing segments, provides for emergencies when run-of-mine or frozen coal must be used. Its 60-in. heavy-rim flywheel, grooved for five V-belts, connects to a 15-hp high-torque motor. The V-belts provide sufficient elasticity in the drive to reduce transmission of shock from the crusher to the motor beyond that absorbed in the heavy flywheel.

The pivoted-bucket conveyor circles the reserve storage bins (246 ft long) and the suspension coal bunker (117 ft long) in the boiler room, Fig. 5. The return strand runs beneath the boiler room floor and the hopper bottoms of the storage bins. This conveyor is 900 ft long and because of this, machinery parts are usually heavy. For example, the head shaft is $5\frac{7}{8}$ in. in diameter with hardened-tooth sprockets. To compensate for the chordal action of the long-pitch chains at the sprockets, the head shaft is driven through equalizing gearing. Final reduction is through cut-spur gearing to a second countershaft, and a silent-chain drive to a 25-hp motor (See insert, Fig. 5). A differential band brake on the second countershaft prevents reversal of travel during abnormal operating conditions.

On the carrier the buckets are 24x24 in., made in one piece of malleable iron. They are suspended on cross rods between two strands of malleable chain by replaceable hardened bearing blocks which are fitted into the dumping cams in the bucket ends. All parts subjected

to wear are readily replaceable. Chain rollers have hardened treads and bushings, and bushings are shouldered and locked rigidly in the side bars. Chain pins are locked in the outer side bars with the roller and pin self lubricating.

The carrier has a rated capacity of 50 to 60 tons per hour at 40 to 50 ft per min, with the buckets loaded to 80% of capacity. Its buckets overlap on the horizontal runs. At the upturn they automatically disengage because of the extended cantilever attachment links. At the top of the lift they again overlap in the proper position to permit dumping. Emergency stop buttons are located along both conveyor runs.

Multi-purpose Conveyor

The conveyor serves three purposes: (1) Delivers coal either to bunker or reserve storage, (2) brings coal from reserve storage to bunker and (3) takes care of the problem of coal overheating in reserve storage. Undercut gates in the hopper bottoms permit taking coal from any section of the reserve storage bins. Along the upper run are two electrically controlled trippers. The first may be set at any point along the 246-ft storage bin, or may be swung down so as not to trip the buckets. If it is swung down the loaded buckets carry on to the second tripper which controls the coal distribution to the boiler-room bunker. Of course, incoming coal may pass direct from cars to the bunker.

Should a temperature rise be noted in the coal in any section of the reserve storage, the coal in that section is rehandled to the top of another bin or to the bunker. A depth of 50 ft is considerably beyond what has been considered a safe limit with bituminous coal, but in this plant where a maximum possible reserve was essential there was no alternative. Under normal conditions the bins will not be loaded full.

Recent experience has shown that spontaneous combustion is not so closely related to depth or pressure as was believed, but is often caused from air circulation and resulting oxidation in the coal mass. Should trouble be experienced with fully loaded bins at the Central Park Ave plant, it can be reduced, if not eliminated, by sealing the gates.

In the boiler room the suspension bunker is gunite lined. Lined bunkers

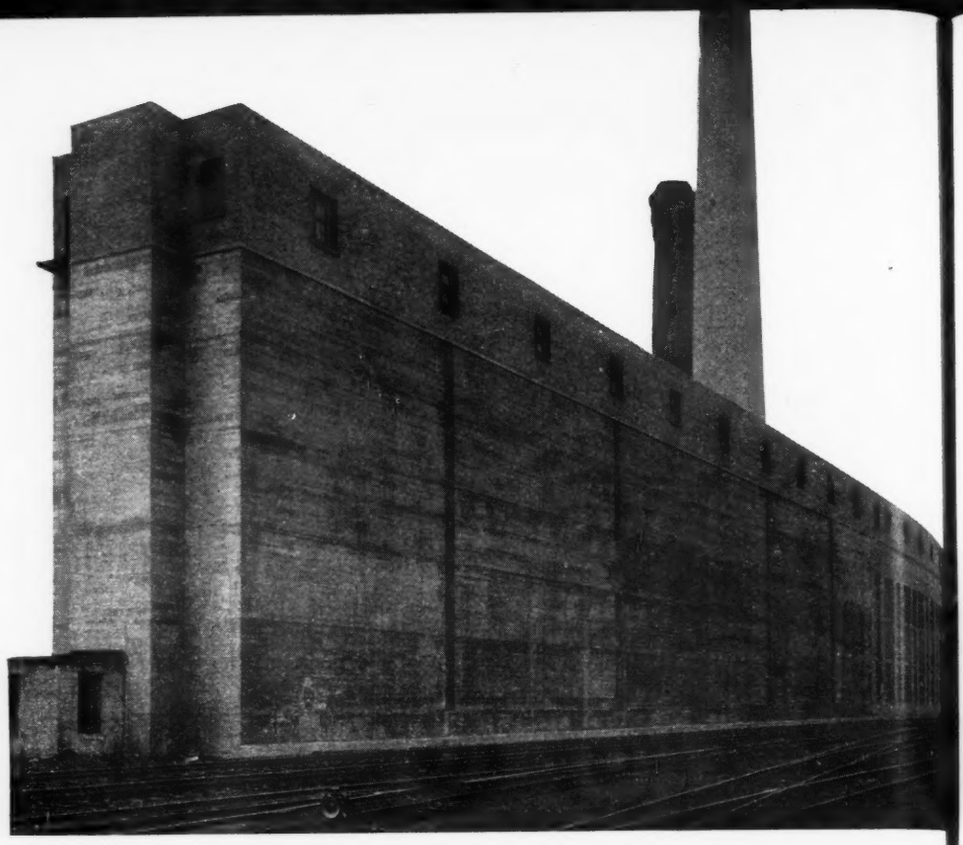


Fig. 2—Coal storage consists of 10 reinforced-concrete bins, 23 feet square by 70 ft high

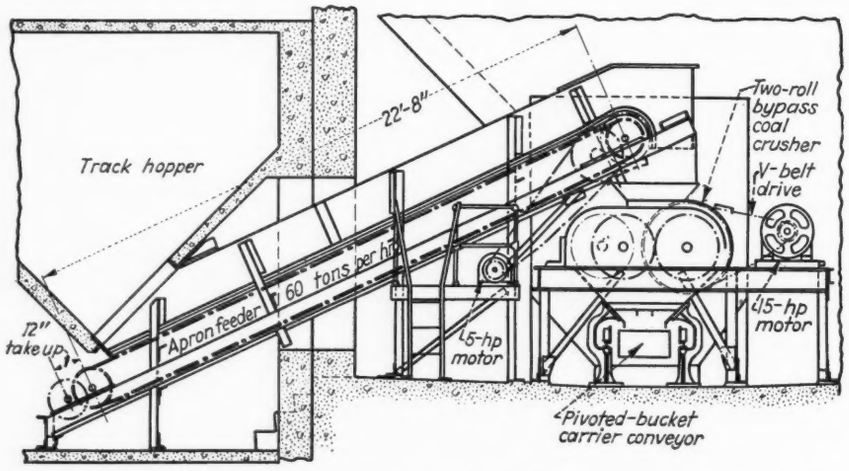


Fig. 3—Beneath the track hopper a 30-in. apron feeder discharges coal to the pivoted bucket conveyor through a crusher driven by a 15-hp motor through a V-belt

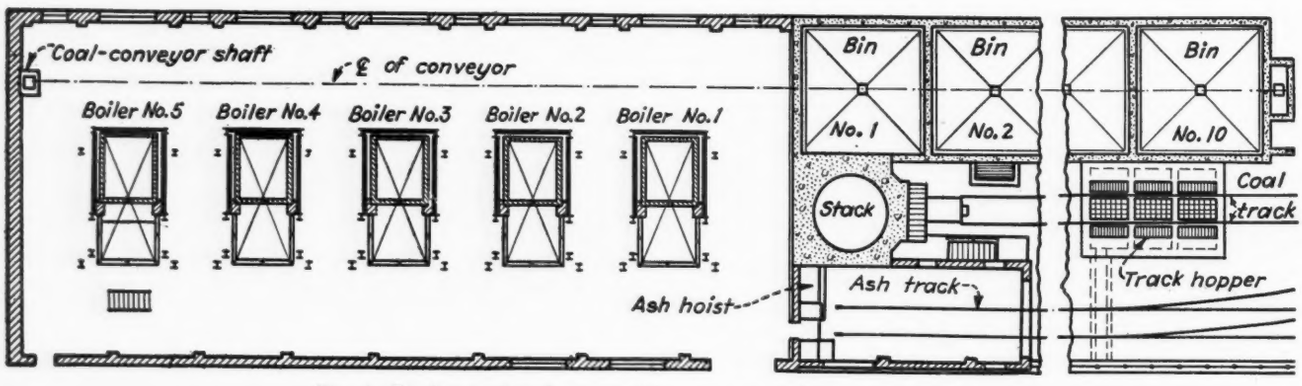


Fig. 4—Bunker and coal storage bins are arranged in a straight line

have been found to be effective in preventing corrosion of the steel envelope. While this lining substantially increases the first cost, maintenance expense is negligible. The writer recently had occasion to make inquiry as to the present condition of a number of concrete-lined suspension coal bunkers erected between 1908 and 1915. All were in as good condition as when first erected, although some were used for actively corrosive damp coal.

Parabolic bunkers are somewhat flexible, changing contour as they are loaded. Their flanks bulge under full and flatten out under partial loading. The bottom of the parabola thus tends to shift up or down appreciably. This deflection tends also to crack the lining and must be provided for in assembling the stoker chutes. An effective preventive is to shape and brace the bunker to a curve corresponding to that which it tries to assume under full load, before applying the lining. The flattening effect under light loads is slight and will not materially affect this contour. Of course, this distortion is much more pronounced with bunkers heavily surcharged, or having considerable storage above the parabola. No trouble should be experienced with this bunker in view of the thick lining, longitudinal stiffened and hoppered concrete bottom.

Although the pivoted-bucket carrier is well adapted to handling both coal and ashes without seriously increasing the maintenance cost, this was not practical in relation to other conditions of the layout. The ash pits are some 18 ft off the plane of the path of the carrier, and the ash bin is still further removed, with the stack between. Furthermore, because of the carrier's length it would not be convenient to correlate the handling of the ashes at one end of the line, with remote coal-handling operations at the other. Therefore a narrow-gage track system, with 21-cu-ft end-dump cars, was installed for transferring ashes to the floor-level receiving hopper of a semi-automatic skip hoist with a 30-cu-ft bucket. On this hoist the bucket makes one round trip and stops automatically. The bucket loader is pivoted and counterweighted, and is normally raised, so that it cannot discharge ashes from the receiving hopper unless the bucket is in position to load.

A standard hoisting machine with 24x18-in machine-grooved drum, forged-steel herringbone gearing, anti-friction sealed bearings, and rigid welded-steel base operates the hoist. Guide sheaves are 24 in. in diameter and cable is $\frac{5}{8}$ in. plowsteel, operating at 100 fpm on a 90-ft lift. It is driven by a 15-hp, 1200-rpm, totally inclosed crane-type motor with 30-min 55-C rating, connected to the high-speed shaft by a flexible coupling, which serves also as the drum for the solenoid brake. Control is by traveling-nut limit switch in weather-proof housing, chain-driven from the intermediate shaft of the hoist.

STOKERS FOR WAR LOADS —AN ACKNOWLEDGMENT

POWER wishes to express its sincere appreciation to American Engineering Co and W S Major, Stoker Division, for their substantial contribution of facts and suggestions to last month's special section "Step-Up Stokers for War Loads". This important credit was inadvertently omitted from the paragraph of acknowledgments at the end of the section, page 78.

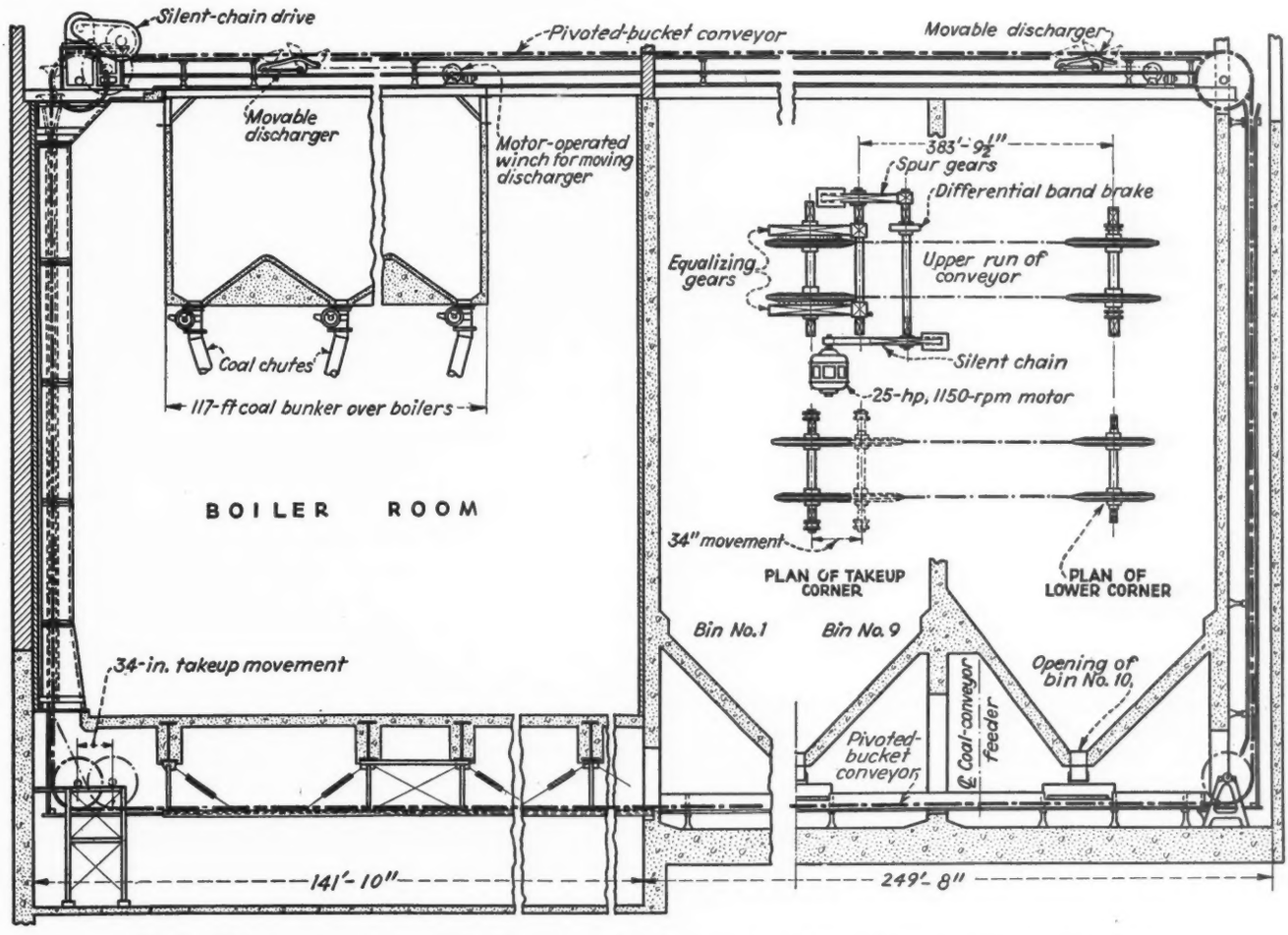


Fig. 5—900-ft conveyor circles the boiler room and coal storage bins, having a total length of nearly 400 ft.

Combustion Control "Keeps 'em Rolling"

Automatic multi-fuel boiler control of latest design meets unusually high requirements for continuous operation, efficiency and safety in a war-production power plant

By C R EARLE
Republic Flow Meters Co

▶ TWO PULVERIZED-COAL AND OIL-FIRED 90,000-lb-per-hr boilers generate steam at 550 psi and 700 F in the power plant of a large cellulose-products works, which cannot be named. Four combination burners, served by two pulverizers, fire each boiler. Forced and induced-draft fans are on a common shaft, driven by a steam turbine. An automatic boiler-control system, embodying many features that promote reliability, safety and efficiency, coordinates the operation of this equipment.

Automatic controls maintain any fuel-air ratio for 1- or 2-mill operation; no adjustment need be made by the operator when load varies. The controls also maintain air supply according to the set fuel-air ratio when oil is burned to supplement the pulverized coal. Indicators show air pressure and fuel rates in linear relation to boiler load.

Amount of either fuel, or the total of the two when burned together, is automatically limited to that corresponding to the air available from the fans so that the furnaces cannot be overloaded with fuel, causing smoke. Minimum rating of each boiler can be set to prevent loss of ignition. If the furnace pressure should become positive or if for any reason the boiler air flow decreases below a set value, the control automatically limits the amount of either or both fuels that can be fed to the furnaces. If a turbine driving a duplex-fan unit trips out, the pulverizers automatically shut down, and the fuel oil valve closes.

Complete centralization of control at the boiler front is one of the features of the plant. The regulators are mounted in a row on a stand in front of the boiler master panel, operating their respective control devices by oil-pressure lines to remote power cylinders or by mechanical linkage, Fig. 1.

In this system, all operations are coordinated by a standard supermaster controller on the left, Fig. 1, in which a steam-pressure element dispatches a master loading-air pressure to a boiler-master for each unit. The boilermaster in turn dispatches the loading pressure to the individual fuel and air regulators of that boiler, causing them to operate in unison to supply fuel and combustion air for constant steam pressure and best combustion efficiency.

Fuel-air ratio is automatically maintained regardless of variations in individual pulverizer load or the shutting

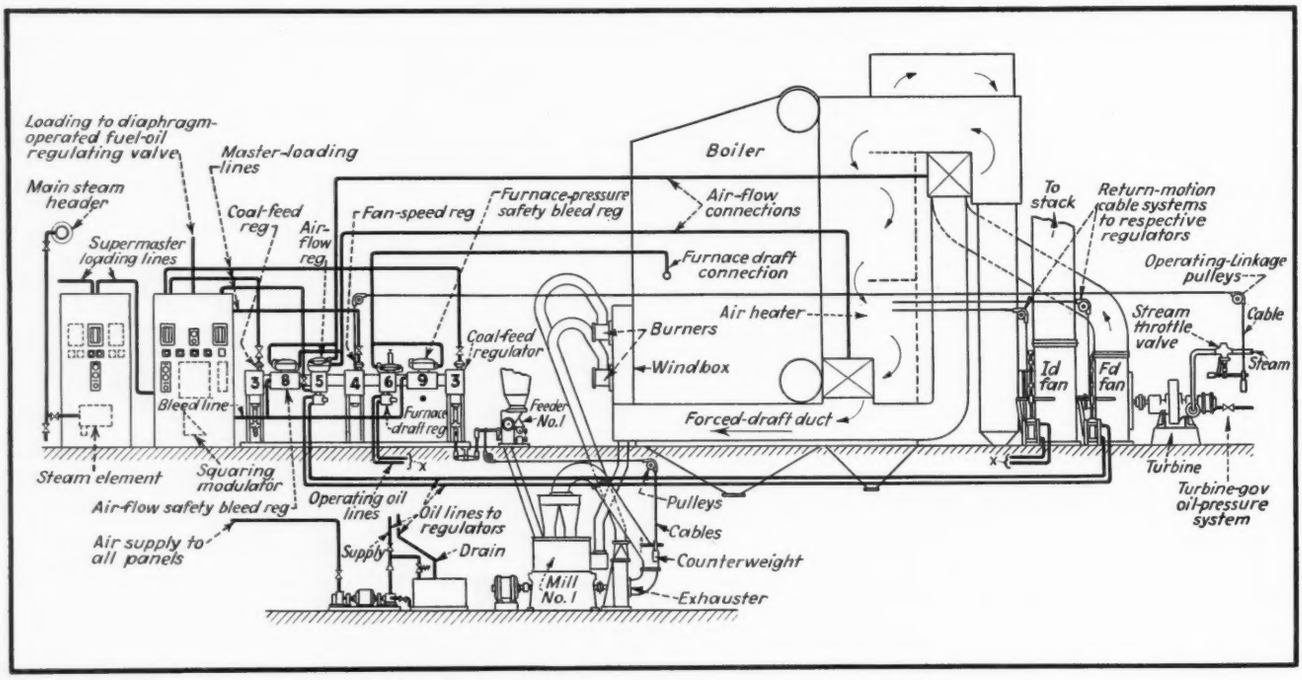


Fig. 1—Boiler regulators, mounted in a row in front of the boiler master panel, operate their respective control devices by oil-pressure lines to remote power cylinders or by mechanical linkages in response to air-pressure impulses from the master controller

down or cutting in of individual pulverizers. On the supermaster panel, Fig. 2, a 2-tube mercury manometer indicates the master loading pressure dispatched to each boiler master panel and represents boiler load. On each boiler master panel are two 2-tube mercury manometers. One indicates the loading pressures dispatched to the fuel-feed regulators on the two pulverizers of square of total fuel supply or boiler load, because in the air-flow regulator the loading pressure must balance a measurement of boiler air flow varying as the square of the load.

The totalizer is a system of diaphragms mounted on a pivoted beam, which controls an air-bleed valve. This assembly constitutes a sending relay that delivers an air-loading pressure burner supply line. Provision is made, however, so that the loading pressure applied to the oil-supply valve is also simultaneously impressed on the totalizer. Thus if the two fuels are being burned and the oil supply is increased, the total air supply will be increased automatically, up to the limits of available fan capacity. In such a case, the fuel-air ratio for the two fuels may not

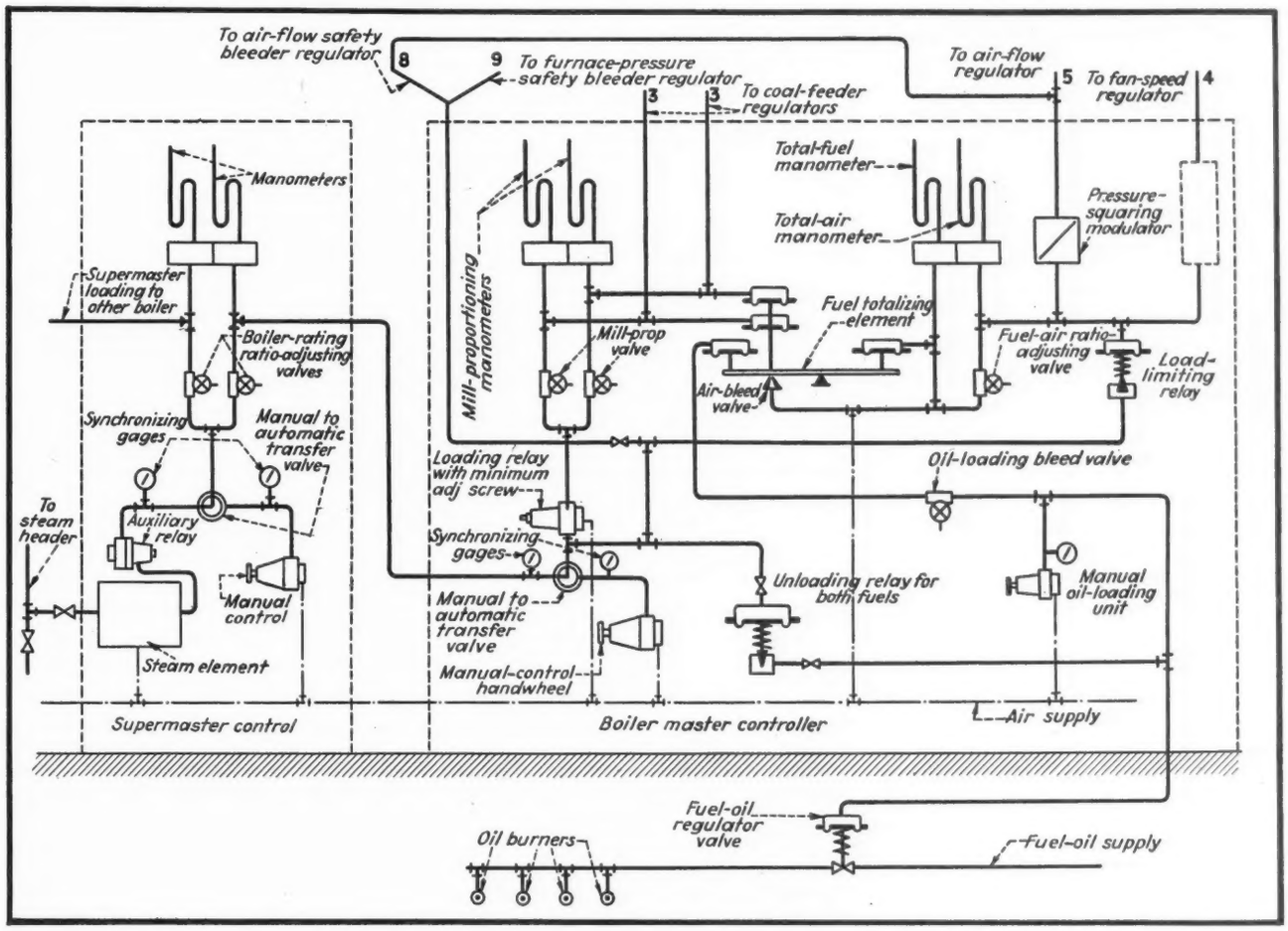


Fig. 2—How supermaster and boiler-master controllers connect to various regulating and indicating manometers and gages

that boiler. In the other manometer one tube indicates total fuel, the other total combustion air.

Master loading pressure dispatched to each fuel regulator is related to mill feeder and damper position by a cam in the regulator. The two mill-loading pressures are dispatched to a totalizer which produces a secondary loading pressure directly proportional to the sum of the two mill-loading pressures. This secondary loading pressure from the totalizer, representing total fuel supply, is indicated by the total fuel manometer and becomes loading pressure for the air-flow regulator. To do this, however, the loading pressure is converted by a pressure-squaring modulator into a pressure varying as the directly proportional to the sum of the individual pressures it receives on its diaphragms. Consequently the delivered loading pressure always represents total fuel supply, regardless of variations in the supply of individual fuels.

On each boiler the four oil burners can carry full load alone if necessary, in case both pulverizers have to be shut down. Each mill has a capacity of 60% of full load on its boiler. If one mill has to be shut down oil must be burned in combination with the coal to carry full load.

Since oil is primarily an emergency fuel at present, control of this fuel is by a hand-operated air-pressure controller that supplies loading pressure to a diaphragm-motor valve in the oil- be exactly correct but the operator can quickly and easily adjust the ratio to suit the new conditions by the fuel-air-ratio valve.

On each boilermaster controller, a load-limiting device prevents the master steam-pressure element from increasing the total fuel beyond available forced- and induced-draft-fan capacity. A minimum-load device can be set to prevent the boiler from going below a predetermined rating in event of a partial disturbance. Also on the manual loading line controlling the oil-burner supply valve an unloading device prevents overloading the furnace with fuel if coal and oil are burned simultaneously beyond the amount of air available from the forced-draft fans.

Suspended Furnace Walls

Refractory furnace walls have to hold heat in, air out. Suspended construction does this better than solid brick and with less maintenance, reasons George P Reintjes, who makes both

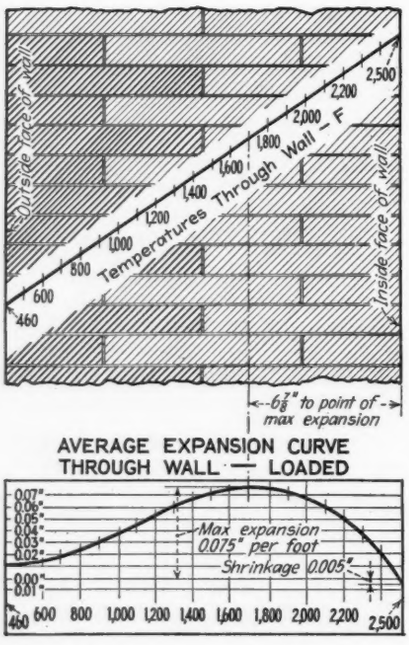


Fig. 1—For many years boiler walls exposed to 2500-F temperature were laid up much the same as building walls except that firebrick faced the hot side

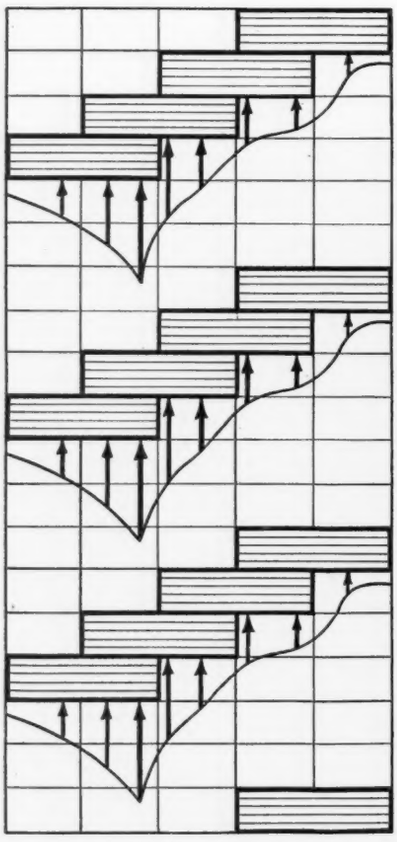


Fig. 2—Upward pressure caused by temperature expansion concentrates about one-third of the thickness back from the fire face, tending to shear ties

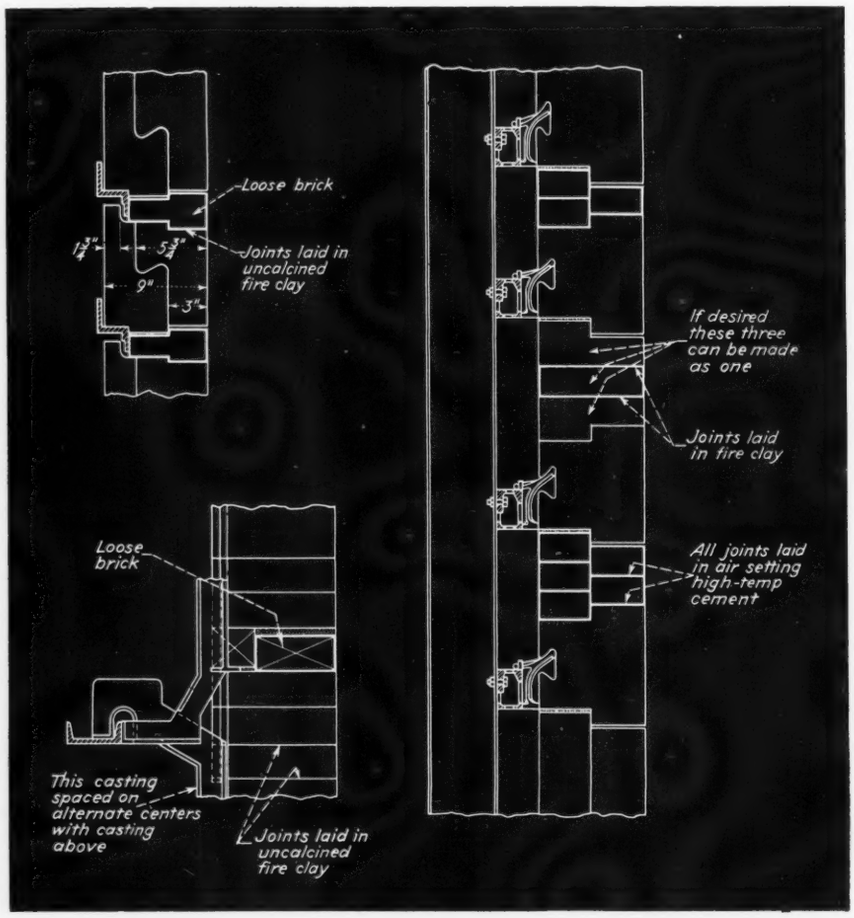
▶ REFRACTORY FURNACE WALLS have problems closely similar to those of structural building walls. Both keep heat in and cold air out. In both, expansion caused by temperature change must be controlled and the weight supported from below or above. Walls have to stand internal or external pressure without misalignment and remain tight under all conditions.

The temperature gradient through a solid wall built up of firebrick and red brick is practically a straight line but the resultant expansion is greatest some distance back from the fire face. High temperatures make the brick nearest the fire more nearly plastic so that most of the weight of a solid wall has to be carried by the brick in the center. Expansion effect, Fig. 2, tends to shear the brick bonding ties.

Adding a layer of insulation between firebrick and red brick increases penetration of the hot zone so that the insulation, Fig. 3, must stand temperatures up to within a few degrees of that in the furnace. The effect of insulating brick on temperature gradient is particularly important for suspended walls if support castings are to be placed between the insulation and the refractory. In general, insulating blocks have a lower coefficient of heat transfer then firebrick or tile.

Expansion upward within the wall is the primary cause of wall linings falling inward. It is also the cause of shearing ties or headers of a solid wall. The movement disintegrates the interior bricks; a wall may be defective, therefore, without showing external cracks. Experienced wall builders aim

Fig. 4—Three types of suspended-wall construction showing how the weight of the wall tile is carried by structural steel. Note location of loose tiles for maintenance


Loose brick
1¾"
5¾"
9"
3"
Joints laid in uncalcined fire clay
If desired these three can be made as one
Joints laid in fire clay
Loose brick
All joints laid in air setting high-temp cement
This casting spaced on alternate centers with casting above
Joints laid in uncalcined fire clay

Give Less Trouble

at laying brick so that small external cracks will appear in the outer face. These indicate that internal movement takes place freely and ties are not broken.

Early types of sectionally supported walls had the supporting metal castings embedded too far within the refractory. Becoming overheated, the castings grew and opened the joints between the supported tiles fanwise. Also, the supports could not be rigidly bolted to the column supports without breakage because of excessive warping.

Warpage also required large joints between belts of tile where the castings were rigidly attached to a metal frame. It was impossible to control expansion by the use of expansion joints except in an upward direction. Metal shoes or supports beneath each belt prevented downward movement.

In those days sectionally supported walls had to be laid in uncalcined fireclay. Shrinkage of the clay between the tiles left enough space to absorb individual tile expansion. Because wall designs were not flexible enough to permit varying joint thickness, considerable difficulty was experienced in keeping the walls tight under conditions of varying temperature in different parts of the wall structure.

Modern wall designs of all manufacturers represent material improvement over earlier walls. Three are shown in Fig. 4. For example, one of the constructions illustrated uses tiles made up in multiples of standard firebrick. Temporary repairs can thus be made with brick taken from a stock pile. Wall tiles bond with standard firebrick around doors and other openings. Each belt is independent of others to allow complete freedom of expansion upward, downward and sidewise. Belt height can be varied to suit individual conditions without special shapes or castings. Supported tiles are offset to break the bond of the brickwork, providing offset expansion joints. Packing, for air tightness, is located away from the hot zone. Finger supports for tiles let each unit expand in any direction.

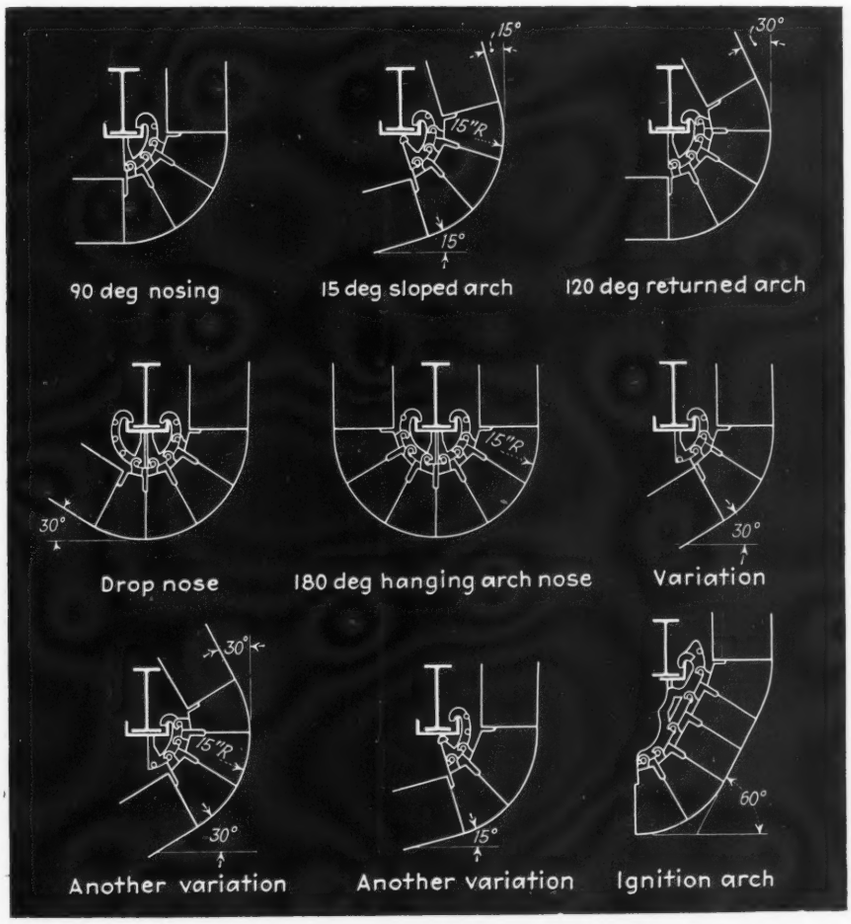
Castings for wall support are subject to cumulative growth if overheating takes place. Box castings have a large area for heat dissipation and give adequate strength against downward or lateral pressure.

It is a generally accepted fact that refractory tile will not give service equal to that of standard firebrick under similar conditions. The more complex the tile shape, the shorter, in general, will be the life of the tile. Walls that include part tile and part firebrick offer advantages over walls constructed entirely of tile.

The ideal location for firebrick shapes in any wall is the "loose" tile row, that is, whichever one is capable of being displaced first in repairing a belt of tiles. All suspended walls have such loose tile or firebrick to enable repair of individual wall sections.

Many engineers believe that sectionally supported walls are superior to the best solid wall. The most usual complaint, on the other hand, is that wall and arch shapes should be further standardized to speed installation without excessive field work.

Fig. 5—Typical flexible-arch construction for various angles of slopes and nosings



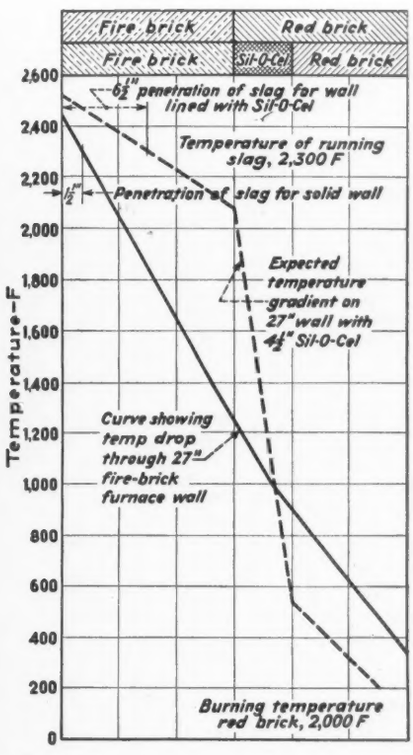


Fig. 3—Temperature gradient for solid walls with insulating block

WARTIME POWER CLINIC

Practical ways to create emergency capacity. Cures for overloads, breakdowns, short-handed staffs, lack of spare parts, etc. Contributions invited at regular rates

Fighting the Battle of Bearings

Users of babbitt and bronze bearings are headed for trouble. It's all on account of tin, and the Japs are to blame. Total world production of tin in 1941 was 232,000 tons, of which the Malay States produced 85,000, Thailand 17,000 and the Netherlands Indies 44,000. With Japan bouncing all over these regions, about half of the world's tin production is completely cut off from the United Nations, so they'll simply have to get along with what tin they can get. That means a lot of things, including no more canned dog food, or even canned pork and beans.

The power engineer will get hit in his bearings, so to speak. His favorite bearing materials are high-tin babbitts and bronzes containing copper and tin. Severe restrictions on the use of these materials is certain. Equally certain is the need to keep industry's wheels turning if we are ever to lick the guys who stole the tin.

All of which means that engineers must immediately line up all the practicable makeshifts—ways to use less bearing metal and ways to use compositions containing less tin—or maybe none at all. To get things started we have interviewed tin conservation experts in the WPB at Washington, and have also made contact with the hard working Bearing Metal Committee of the American Society for Testing Materials; they may have something soon. In addition POWER has invited several leading experts on bearings and bearing metals to tell what they know in May POWER.

Now let's round this out with the practical observations of bearing users—the power engineers. If you know, tell your fellow engineers what to do if the usual replacements are not available the next time a critical bearing fails! Summarize your experiences with unusual alloys or bearing designs, with emergency methods of lubricating and cooling. Keep practical. Include sketches where they will help. Bear down on bearings while there's time!

Cut Down Papa's Pants for Junior

SEVERAL OF OUR PUMPS needed new bronze rods about the same time. These were boiler-feed pumps, vacuum pumps and a duplex brine pump with rod diameters of 1⅝, 1½ and 1⅜ in., respectively. We found it difficult to obtain new rods because of wartime conditions, priorities, etc.

Our plant isn't large enough to require the services of a machinist, but we have a lathe that has not been used for several years. One of our engineers had been a lathe hand before obtaining his license and decided to do something about our problem. He got busy and put the lathe in good working order.

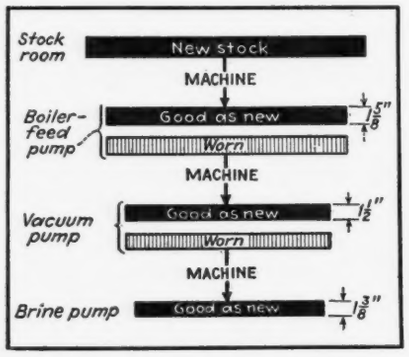
Hunting through our stock room, we found a piece of bronze stock of sufficient length and diameter to make two new rods for our boiler-feed pumps.

The old rods from this pump had sufficient stock to turn down to make new rods for the vacuum pumps. The worn rods from the vacuum pumps, in turn, were machined down to make new rods for the duplex brine pump.

From miscellaneous pieces of scrap bronze, worn bearings, etc, the packing glands on all the pumps were rebushed to fit the new rods. New neck bushings were also made up.

Now we have three new sets of pump rods, with little loss of material. Moreover, our packing troubles have been cured for some time to come.

Believe it or not, the old pump rods last removed (duplex brine pump) will be used in the near future to make up new rods for our duplex sump pump, the smallest pump we have in service.



Each worn pump rod was machined to fit the next smaller pump, thus saving hard-to-get bronze rod

New York, N. Y. ANTHONY GREER

Quick Repairs by Welding

ARC WELDING IS HELPING many plants maintain power services in the war emergency. The process is used extensively in power plants throughout the country to repair broken and worn parts of turbines, shaftings, valves and conveyors—also in structural and piping construction and general repair.

For instance, the steel casting on the gland-seal turbine runner in a large Great Lakes power plant was badly steam cut. It would have cost $917 to replace the casting. The part was successfully repaired by welding at a small fraction of this replacement cost. The worn face was chipped clean and the original dimensions restored by application of new steel by arc welding. The material ranged between ¾ and ⅞ in. in thickness and was welded with 5/32-in. electrodes in about four hours.

At another plant, a broken 27½-ft shaft of a 600-hp motor was repaired by arc welding at a saving of more than

$4000. One power plant reported the repair for $20 of valves costing $400.

Cleveland, Ohio A F DAVIS
Vice President, Lincoln Electric Co.

One Column Around Another

THE EXTRA BURDEN PLACED on plants throughout the country has required extension of space, installation of new equipment and the repair of old machinery and structures.

Arc welding has played an important part in this program because it speeds the return to service of broken parts or the extension of facilities, saves valuable man-hours and salvages scrap pipe or old steel shapes and plates.

The photographs show how engineers of one power plant strengthened the building by erecting welded columns of ingenious design. Four of the columns extend all the way to the top of the four-story building. It was necessary to reinforce the original cast-iron columns in order to carry the additional load caused by installation of new machinery and equipment throughout the building.

Columns were strengthened by splitting 18-in. steel pipe longitudinally and welding the two halves together to encircle the cast-iron column. The space between the pipe and the old column was then filled with concrete.

This application of arc welding avoided jacking up the building for the removal of old columns and the installation of new ones. It saved time and money. New cast columns could not have been obtained readily, but scrap steel pipe was relatively plentiful despite the shortage of other forms of steel.

Cleveland, Ohio A F DAVIS
Vice President, Lincoln Electric Co.

Consultant Attacks "Sloppy Operation"

POWER asked a consulting engineer of long experience in plant design and construction to have his say on this matter of getting the most out of existing power equipment. His reply "burned the paper," but here it is, with names and places deleted to avoid personalities.

Discussion is invited, but there's a war on, so argument about who is to blame is of interest only in so far as it shows us how to do things better next time.—*Editor.*

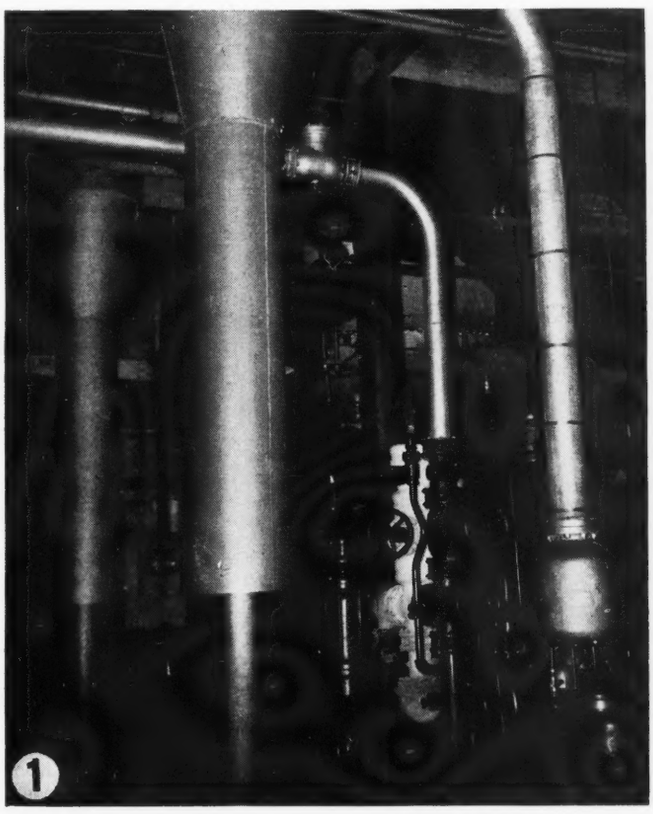
YOUR WARTIME POWER CLINIC is right in line with some of my own thinking. I have watched some plant operators, and been cussed out by others for doing things they didn't approve of simply because they couldn't grasp the fallacies and limitations of their own proposals.

It seems to me that the first job on the list is one of education. Each man working around a power plant should know (and know thoroughly) what his job is, and how to take care of trouble that might develop.

Not only that; he should know just how much load each piece of equipment can stand without damage. I have observed the tendency of all plant operators to "hedge" on equipment capacity. They always want a reserve of about 20 to 50% in each turbo-generator, boiler, boiler-feed pump, so that they can have more hours of checker playing and reading. If efficient use is to be made of generating facilities many operators and plant chiefs must learn that when the nameplate on a turbo-generator reads 1000 kw it means the unit is good for 1000 kw, not 700 or 750 kw.

Don't say "it can't happen here," because I've been in too many plants where the operators go into hysterics when the load on a turbine, or a diesel exceeds about 75% of rated capacity. I'd bet a quart of good scotch that many, many plants could increase their energy output 30% by the simple expedient of utilizing the nameplate generating capacity. No man ever won a

Figs. 1 and 2—Welded outer shell and concrete filler reinforce old cast-iron columns



race going at three-fourths speed.

Now I'm going to relate a little experience that cost the City of Blank a neat sum of money, as well as a 20-hour shutdown of their power plant, simply because an operator (who, incidentally, had had about 15 years' experience in that plant) didn't know what to do when trouble broke. He had two 600- and one 1500-kva hydro units in operation. Apparently a current transformer on one of the 600-kva units let go, starting a fire in the generator leads between the generator oil switch and the generator. The fireworks spread over to the oil switches of the other unit, and everything was "going to Hell in a handbasket".

Instead of pulling the excitation off all three machines, this operator started running around with his hands in the air, and the operating chief had to send a lineman up to the plant to shut off the trouble. To this day, the operator doesn't know, despite the amount of explaining that has been done, that the exciters had to be shut down, or that the water to the turbines should have been shut off. All he knew was that if she was going to burn—let her burn. "What else could a fellow do in a case like that?"

That's a horrible example of lack of knowledge on the part of an operator. It seems almost inexcusable in this day and age, but it did happen, and within the past five months. My own personal experience in clarifying operating procedures for my information has led me to believe that too much fundamental information is left to chance. In view of this situation, I'm not a bit surprised that this operator didn't know that a hand grenade was tied up in the innocent-looking exciters on these machines.

This condition exists for two reasons. First, the information when made available to them was not geared to their ability to grasp it, and, secondly, most folks are too lazy to stir themselves to find out what makes equipment tick.

I think we can agree that the operation of any power plant presents no particular difficulties as long as all of the equipment is functioning properly. But when some equipment starts acting up with the perversity of a balky mule, the skill of the operating staff is tested to the limit.

The next few years are going to tell us just how successful a lot of operating men really are. I personally know of many who are in the habit of enlarging their power plants just to keep from having to do a real maintenance job on the equipment installed. That day is over, and many of these men are going to have to find out just how to get everything possible out of their existing equipment.

Emergency Kinks for Oil Burners

ONCE IN A WHILE it happens that all boilers are out of service and cold, which means no steam to start up fires or run the oil pumps. This had happened to us in St. Nazaire, France, back in 1918. We were lying out in the harbor waiting our turn to dock, which sometimes took a week. Something went haywire (I can't just remember what), so we had to kill every boiler on the ship completely to make the repairs.

Nobody gave a thought to the problem of raising steam again until we faced it after the repairs were made. Among us we got up the idea pictured in Fig. 1, and it worked perfectly. The copper coil was wound up from tubing and connected between the oil supply and the burner. We borrowed an iron pot from the cook's galley, laid it on the bricks and filled it with oil-soaked waste.

While this was burning briskly we forced the oil through the coils with a hand pump, everybody taking a crack at the pumping to insure a steady flow. If my memory serves me right, it took about an hour and a half to get up enough steam so we could remove the coil and finish getting up steam with regular equipment.

On this same ship we always had trouble keeping a uniform oil temperature. Our heaters (Fig. 2) were of the counter-current type and were piped for parallel operation. We figured series operation would improve matters and arranged for this very simply by cutting the oil lines in the two places indicated and inserting in each a valve (kept closed) and a union.

The series arrangement worked nicely and kept a more uniform oil temperature. There was no noticeable increase in oil pressure, probably because the heaters were amply large for the original arrangement. The flow of steam was not changed.

While these kinks date back to the first World War, I figure that they may be both new and helpful to some of the young fellows suddenly faced with the emergency operating problems of this war.

Englewood, N. J. R BOETTINGER

Silver Plating Cools Circuit Breakers

A CONNECTICUT PLANT we can't name had trouble with its oil circuit breakers; they were overheating from overloads. Attempts were made to improve conditions by realignment and better adjustment—also by increasing the contact surface between lugs and feeders. These measures did not reduce temperatures appreciably. Then silver-plating the breaker contacts was tried. Troubles ceased. There's no shortage of silver if you've got the price.

New Haven, Conn. FIELD EDITOR

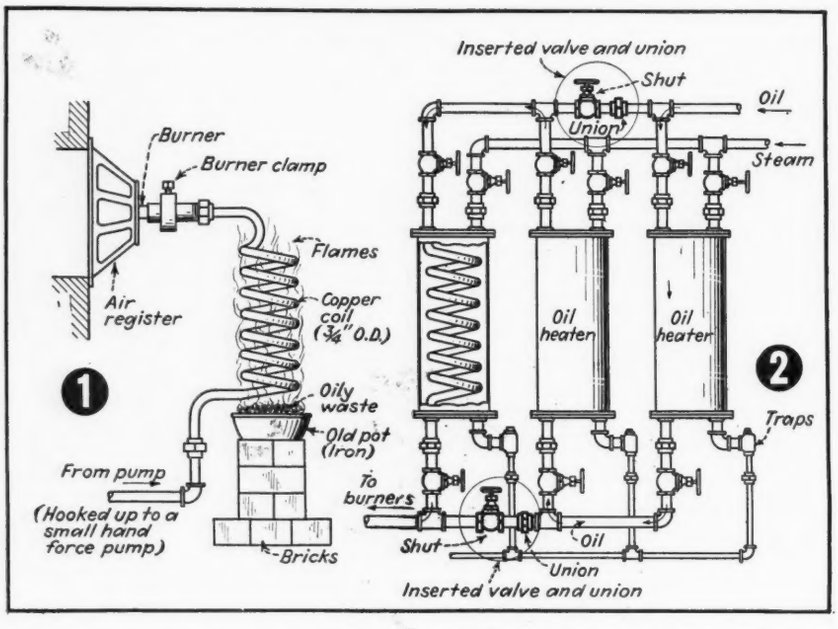
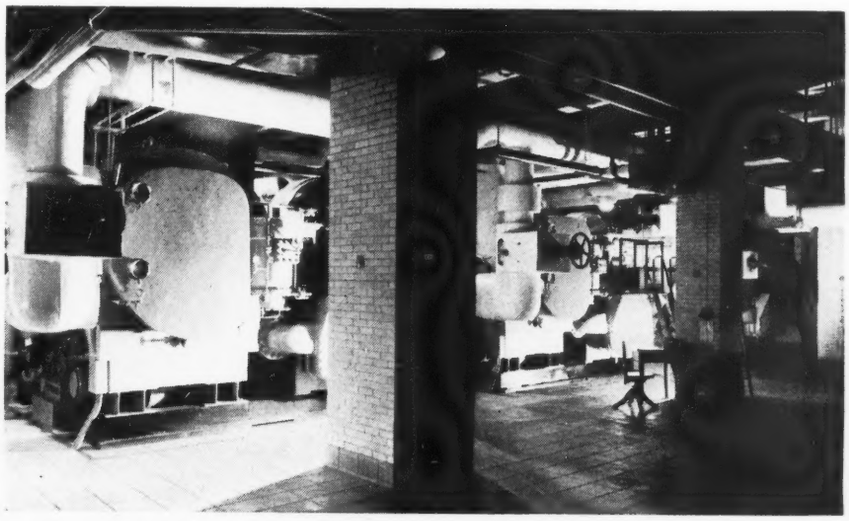


Fig. 1—Emergency oil heater for starting up cold boiler when no other steam source is available. Fig. 2—Insertion of two valves and two unions shifted three oil heaters from parallel to series, speeding up heating and giving a more uniform oil temperature

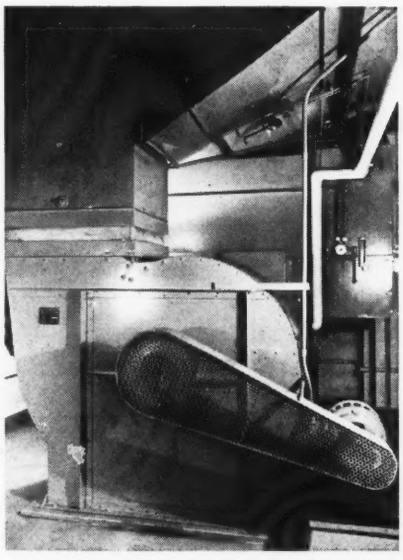
25,000,000 Cubic Feet Of AIR CONDITIONING

The Metropolitan Life Insurance Co's air-conditioning installations rank with the largest and, even more important, with the best in operation and maintenance. This picture "tour" of Units 1 and 2 of the company's New York home-office buildings shows better than words the good housekeeping that characterizes the plant and the intelligent operation that always accompanies top-notch maintenance (see page 68 for details of conditioning equipment, arrangement and control)

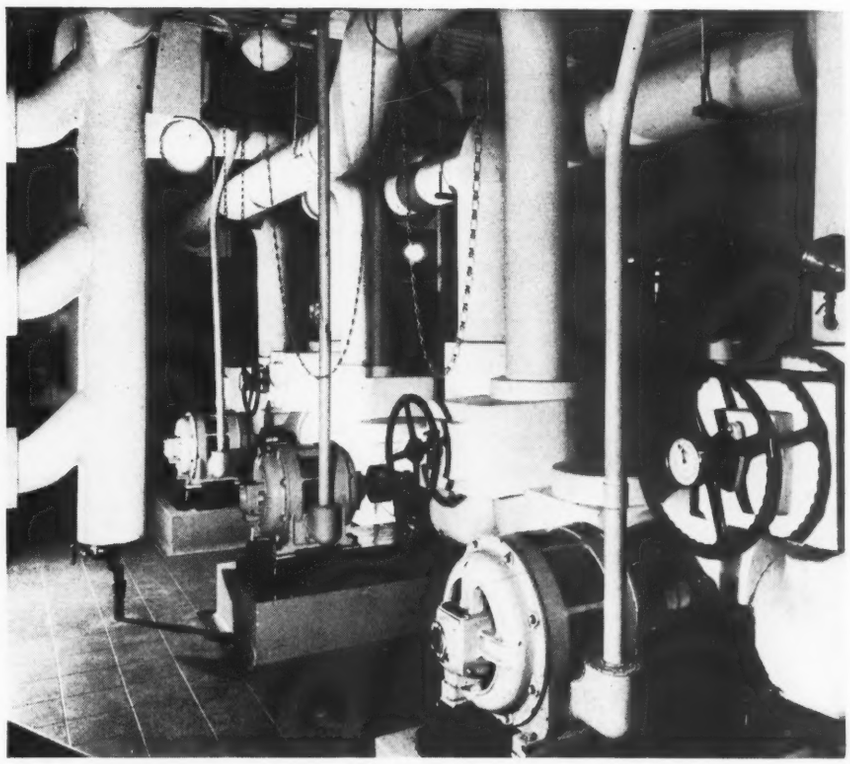


The "tour" starts with the centrifugal refrigeration units, heart of the system. These three 600-ton turbine-driven machines supply Unit 2 and will take care of Unit 3 when it is built

Circulation of chilled water to the conditioning units depends on these 1600-gpm pumps in Unit 1. They take water returned from the system and force it through the coolers on the compressor units, then, through heat exchangers supplying the basement washers to the main washers on the 15th floor. Valve-position indicators permit accurate load division between working pumps; one unit serves as standby



Typical booster-fan unit draws conditioned air from the main supply duct and blends it with air returned from the office space. In Unit 1, there are two boosters per floor, one supplying the north half and the other the south. In Unit 2 each floor is divided into an inner and outer zone, with one fan supplying each



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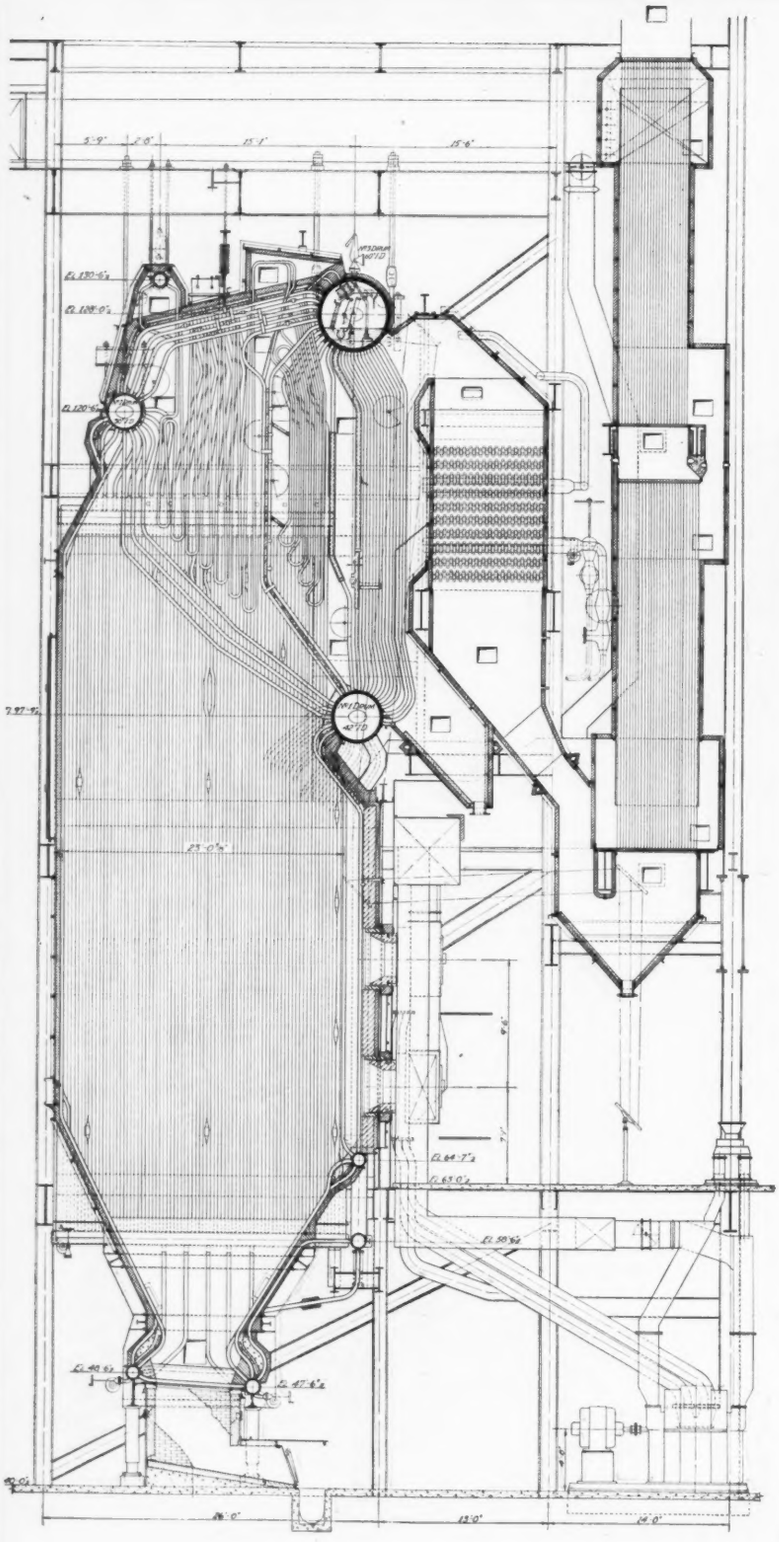
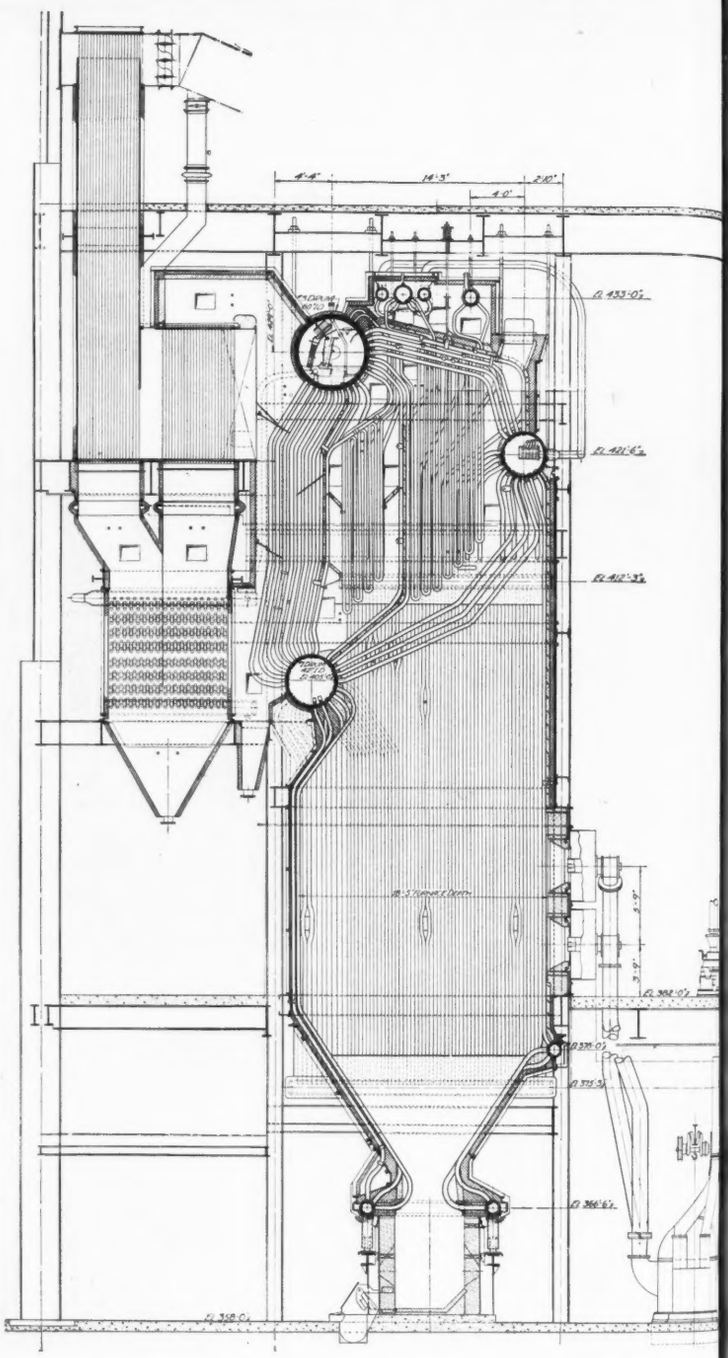
A Few Recent RILEY Units





Southern Ind. Gas & Electric Co., Evansville, Ind.
(Commonwealth & Southern Corp. Property)
225,000 lbs. of steam per hour
900 lbs. Pressure. 900° F. Total Temp.

Union Electric Co. of Ill., Venice, Ill.
370,000 lbs. of steam per hour
1000 lbs. Pressure. 915° F. Total Temp.

TRADE MARK Rx REGISTERED

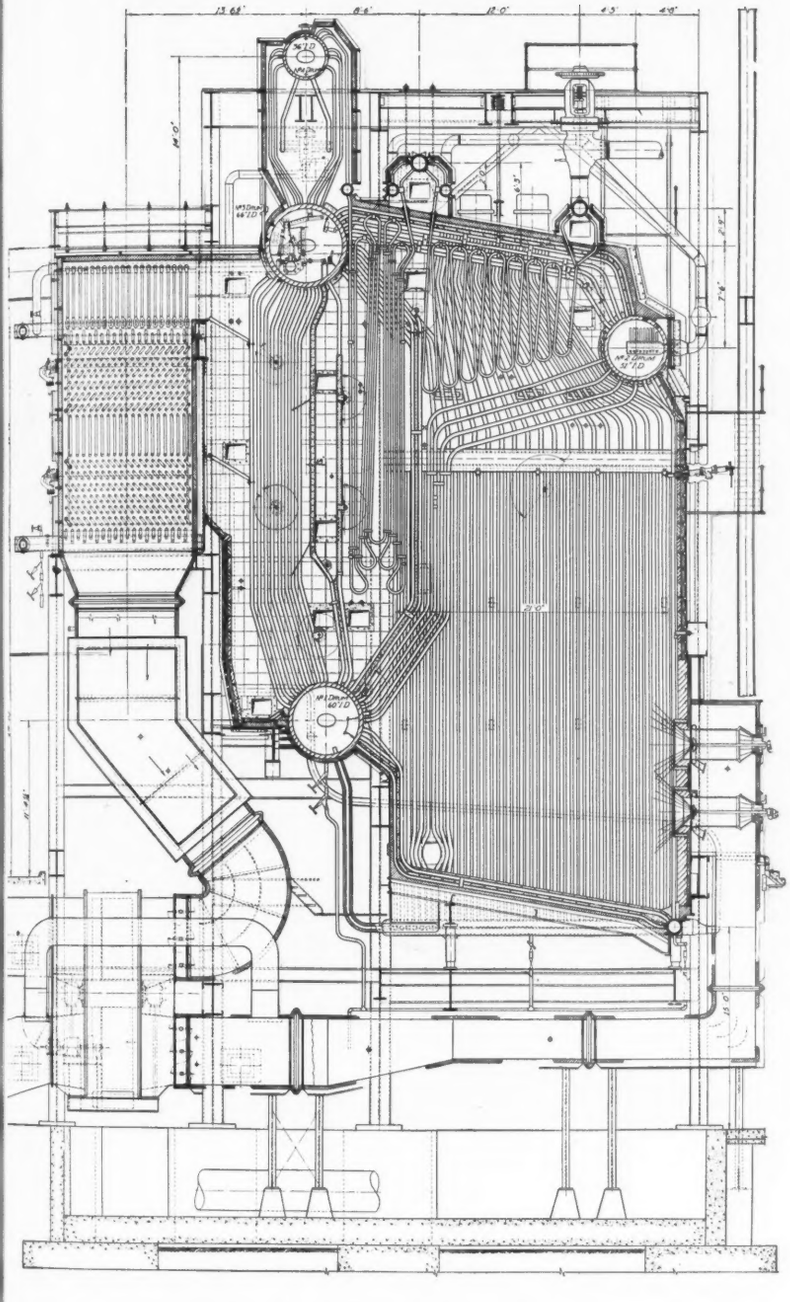
RILEY

STOKER CORPORATION, WORCESTER, MASS.

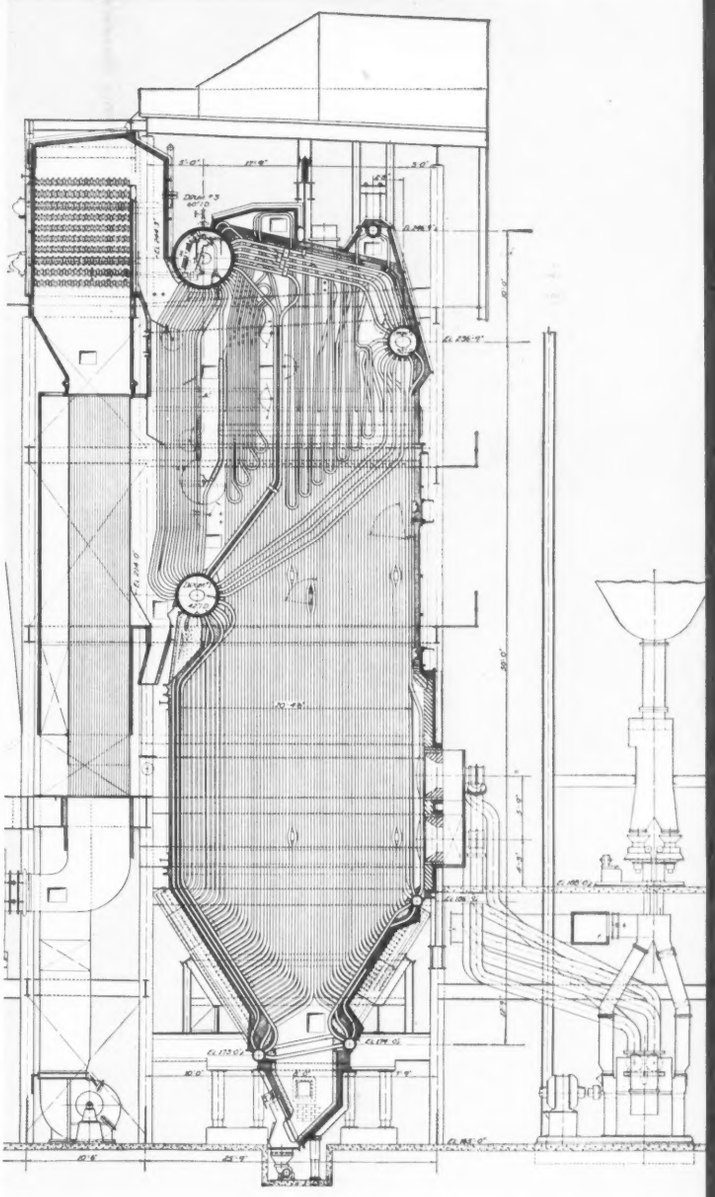
Boston New York Philadelphia Pittsburgh Baltimore Buffalo Cleveland Detroit Chicago St. Louis Cincinnati
St. Paul Kansas City Denver Seattle Portland Los Angeles Houston New Orleans Atlanta Memphis Richmond

It will pay you to visit modern Riley Installations

for Leading Central Stations



City of Los Angeles, Dept. of Water & Power
Harbor Steam Plant
675,000 lbs. of steam per hour
1091 lbs. Pressure. 915° F. Total Temp.



Carolina Power & Light Co., Cape Fear Station
Moncure, N. C.
330,000 lbs. of steam per hour
1025 lbs. Pressure. 905° F. Total Temp.

THE country's leading public utility companies are installing many Riley Steam Generating Units. Four typical recent Riley central station units are illustrated. This general acceptance of Riley Units by the public utility companies, whose very existence depends upon the economical generation of steam and power and its distribution, is positive evidence of the outstanding performance of Riley Units—their high efficiency coupled with dependable continuity of operation and negligible maintenance.

A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs

COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • AIR HEATERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • FLUE GAS SCRUBBERS

before purchasing Boiler or Fuel Burning Equipment

25,000,000 Cubic Feet OF AIR CONDITIONING

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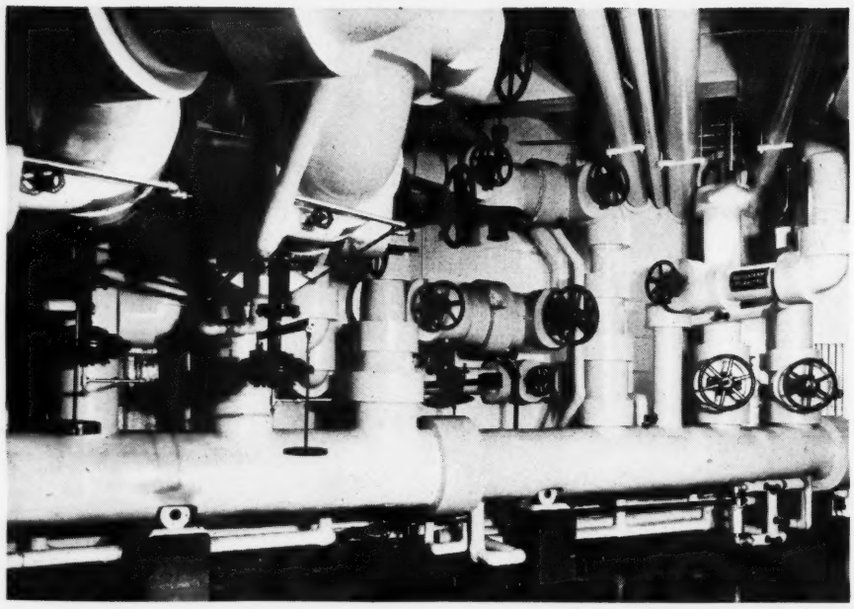
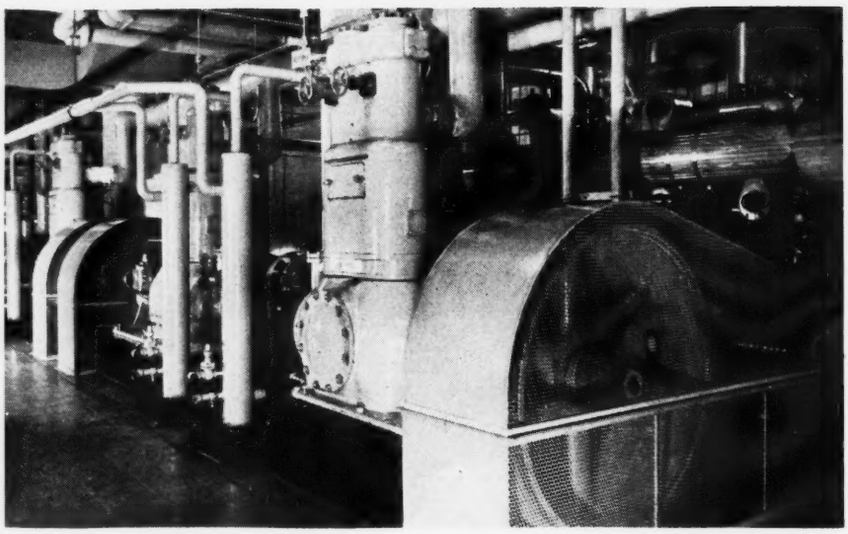
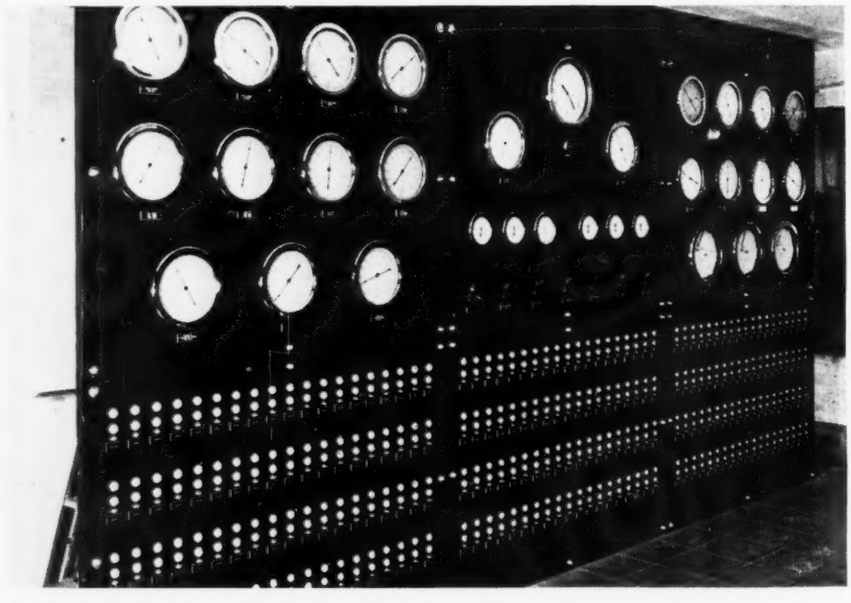


This header room on the 15th floor of Unit 1 is a center for steam distribution and control. The main riser (50 psi) supplies the right-hand end of the header; a branch leads up to the 26th floor. After passage through the main reducing valve, steam enters the left-hand end of the header at 10 psi. Individual air-actuated reducing valves control pressure of steam flowing through the branches to the heating system in accordance with outside temperature, varying pressure from slightly less than one pound to 10–15 in. Hg vacuum



The three 40-ton CO_2 units in the foreground supply general-service refrigeration in Unit 1, for drinking-water chilling and for restaurant and kitchen boxes. A small 7-ton machine at the extreme left operates at a lower suction pressure to cool low-temperature meat boxes



Control of air-conditioning, refrigeration, heating, and miscellaneous building services centers on this board, just completed. Meters at upper left show heating-system and header pressures and vacuums for Unit 2, with dummy dials for Unit 3 gages to be added later. The six center dials (below clock and steam-pressure gages) show control-air pressure on the various parts of the direct heating system, with switches below to change from day to night or week-end operation. The right-hand panel carries gages for main air-receiver pressure, heating system and header pressures and vacuums (Unit 1) as well as gages for street steam and water pressures and main control-air pressure

The signal lights across the lower part of the board keep the control-room engineer accurately informed of the operation of all major items of building equipment. When a given machine is to be started, a switch is thrown at the board to put the signal relays in action. While the machine runs, neither the upper red light nor the lower green light shows. If the machine stops for any reason, the red light glows and a warning bell rings. If a machine is started when it shouldn't be (without throwing switch at control board), the green light shows and a warning gong sounds. Lighting of both green and red signals shows that the machine is properly shut down. Relay units are designed with jack bases so that a defective unit can be removed and a spare inserted without interrupting operation

MORE POWER FROM EXISTING EQUIPMENT—3

Practical suggestions for increasing capacity quickly and with minimum use of strategic materials

STRETCH NAMEPLATE KILOWATTS TO SPEED WAR PRODUCTION

BY F A ANNETT
Associate Editor

If you face increased loads but can't buy new electrical equipment, check the summary below for quick ways to get more out of the generators, motors, transformers and feeders that you have and then read the following pages for practical methods and precautions

GENERATORS, MOTORS

To stretch capacity safely:

1—Load machines according to temperature ratings specified for continuous operation, watching temperatures closely

2—Cool ambient air by installing a fan or using cooler water in the cooling circuit (see pg 93 for precautions)

3—Remember that you can overload heavily for short periods

4—Remember that in a real emergency you can carry winding temperatures 18 F above normal safe limit for several weeks without immediate trouble, but insulation life will be reduced

CONDUCTORS

To stretch capacity safely:

1—Apply forced cooling

2—Remove cables from blanketing concrete ducts, particularly in hot floors or ceilings, and install them outside

3—Use special boosting transformers or other devices to cure "limping" voltage at the end of long lines

TRANSFORMERS

To stretch capacity safely:

1—Load to safe oil-temperature limit for continuous operation

2—Remember: overloads to 100% can be carried for short periods

3—Be sure oil is clean and coils free from sludge, or coils may be hotter than oil where temperature is measured

4—Whatever the cooling medium, lower its temperature and circulate it faster—for example, spray water on tank

5—Connect three transformers delta delta to be ready for emergency trouble; two units can carry a good part of the load open delta if one has to be repaired

POWER FACTOR

Improvement of pf helps all along the line:

1—Increases kilowatt capacity of generator

2—Increases transformer capacity

3—Reduces line losses

4—Reduces voltage drop in line

5—Increases kilowatt capacity of conductors

Already industry's electrical facilities are heavily stressed by mounting war production on the one hand and pinched by wartime equipment limitations on the other. Generators, motors, transformers and feeders must carry heavier loads for longer hours at the very time when outages can't be excused, when experienced operators and maintenance men are leaving for the armed forces—above all at a time when supplies are difficult to get and new main units often unobtainable.

This situation calls loudly for intense application of that practical sense for which American plant men are noted. In every plant facing these conditions the engineer must find ways to "sweat" more than the nameplate rating out of his electrical equipment and still dodge embarrassing breakdowns.

Normal standards and practices have to be revised in times like these. To win a war we have to find what a machine can really stand in the way of overload, if it is forced to the limit and at the same time coddled and protected from unnecessary damage.

Facing this situation squarely, the present article will show how to work to the load limit with electrical equipment and how to tell when that limit is reached. It will cover generators, motors, transformers and feeders, with emphasis on the sizes and types commonly found in the manufacturing industries.

Use these suggestions as guides to action but if there is any doubt as to safety in a particular case, consult the manufacturer of your equipment. Only the maker can set exact limits for a specific unit under specific conditions.

Nine times out of ten, with any of this equipment, the load limit is set by the destructive effect of high temperature on insulation. It follows that the art of overloading electrical equipment without disaster is largely one of watching the temperature at the critical spots in the machine, meanwhile using any available schemes to keep that temperature safe to insulation while carrying heavy load.

Fighting Heat in Generators, Motors

Factors determining how far a particular machine may be loaded include type and design of machine, ventilating arrangements, kind of load, and ambient temperature (temperature of surrounding air). Yet these will simmer down to the difference between actual temperature of the insulation and that which it can withstand.

The inorganic insulations (class B) can withstand much higher temperatures than the organic (class A). Examples of class A are (1) cotton, silk, paper, etc., impregnated with, or immersed in, a liquid dielectric; (2) molded and laminated materials with cellulose filler, phenolic and similar resins; (3) sheets and films of cellulose acetate and similar materials, and (4) varnishes or enamels applied directly to the conductors.

Class B insulations include mica, asbestos, glass fibre, etc, in built-up form with a small amount of class A purely as a binder.

When considering temperature as a load limitation, distinguish between temperature *rise* and actual temperature. It is the actual temperature at the hottest spot, not the temperature *rise*, that puts the insulation out of commission.

Established standards divide turbine generators into two classes: those rated 750 kva and less, and those rated for over 750 kva. Turbine-generators are totally enclosed and forced ventilated in several different ways, depending on the age of the machine, its size and speed.

Machines for 750-kva capacity and less with class A insulation on the windings are designed to carry full load continuously with a temperature rise of 50 C (90 F). When these generators are insulated with class B insulation, a temperature rise of 70 C (126 F) by thermometer is standard for rated full-load continuous operation.

Turbine generators rated above 750 kva have their stator-winding temperatures measured with temperature detectors in the slots between the coils, as in Fig. 2. Because these indicators measure more nearly the hottest-spot temperature of the copper inside the insulation a temperature rise of 60 C is standard for class A and 80 C for class B insulation. Other ac generators, frequency changers, synchronous condensers, low-speed and 2-pole motors have temperature ratings similar to turbine generators. In all these ratings the ambient temperature is assumed to be 40 C (104 F) or less. Based on a

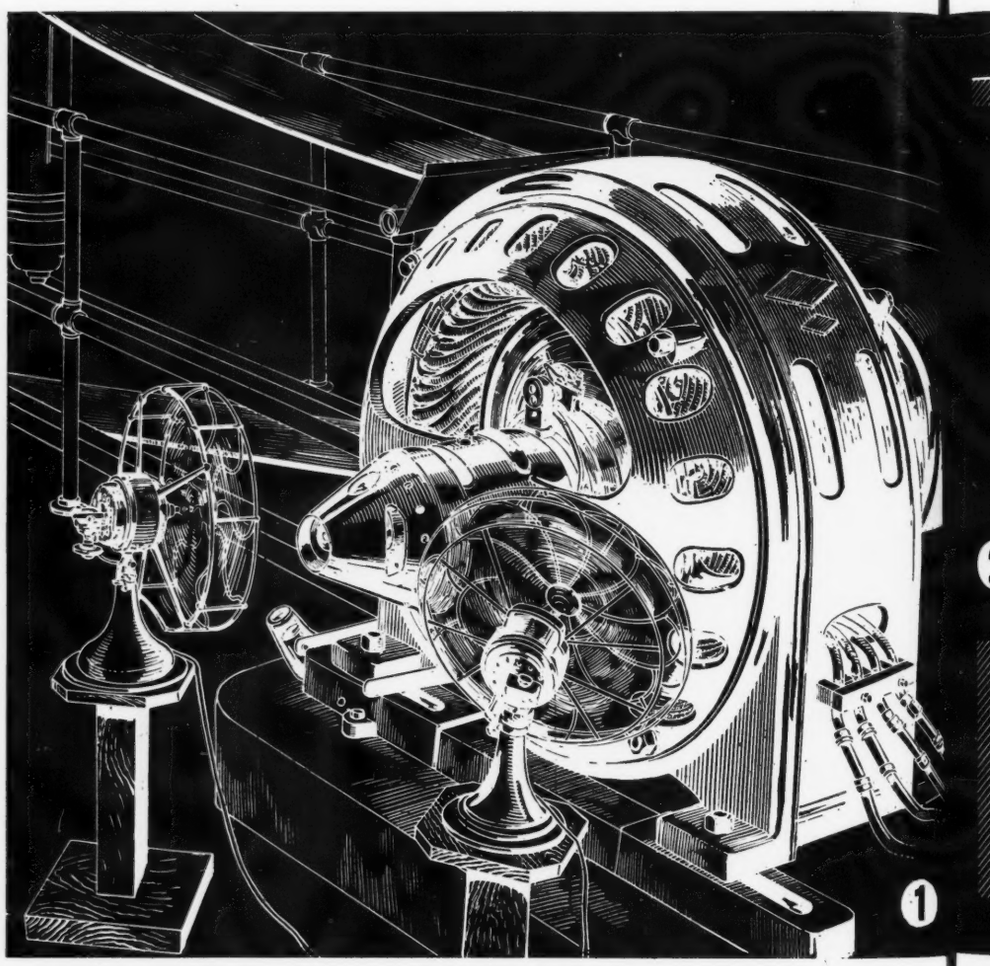
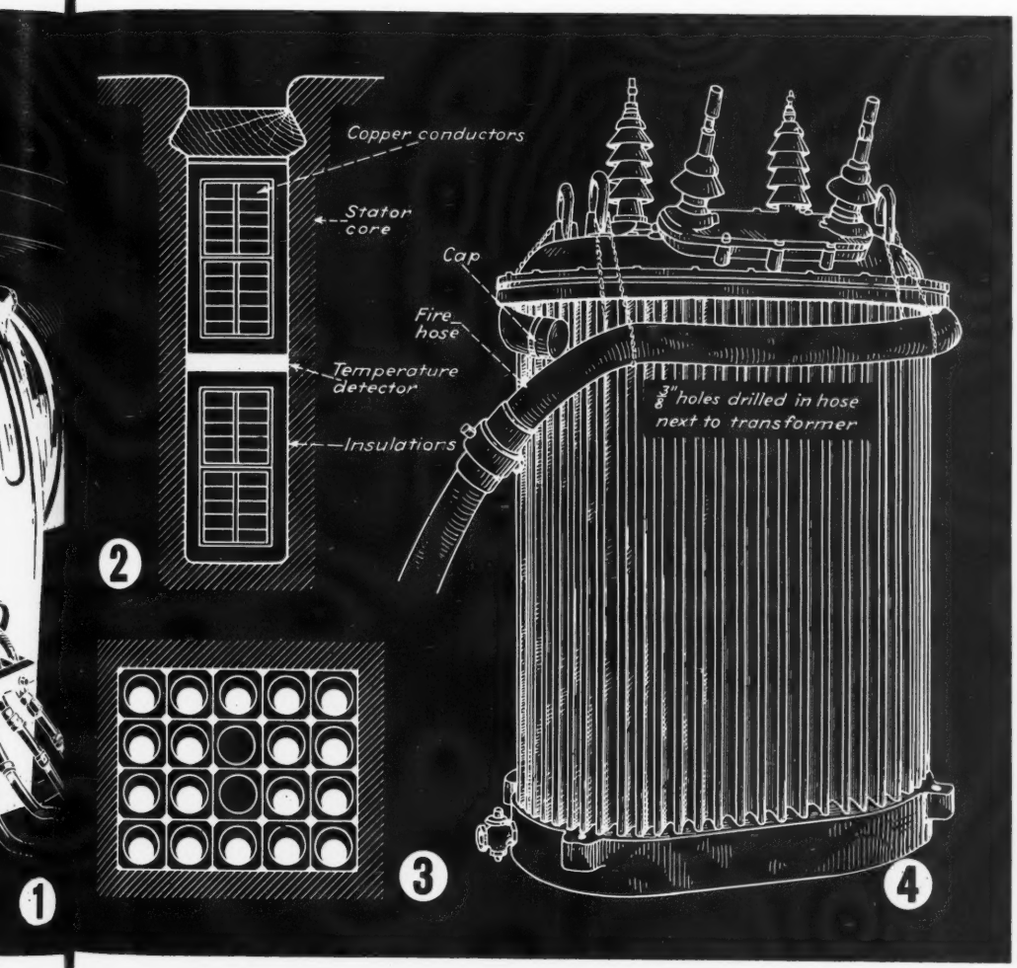


Fig. 1—Self-ventilated motors or generators handle more load safely if fan cooled Fig. 2—Generators of 750-kva and up usually have temperature indicators set permanently between stator coils; these show when load reaches safe limit. Fig. 3—Sub-

40-C ambient, the temperature rise given for these machines sets the safe maximum at 105 C (221 F) for class A and 130 C (256 F) for class B insulation.

Generators for peak-load service may be designed for 25% overload rating for two hours. In emergency this excess capacity can be used to supply about 15% continuous overload without exceeding a safe temperature rise. General-purpose motors have a 1.15 service factor permitting them to operate continuously 15% above normal



tracting center cables from bank to make space for cooling air blast will increase capacity in most cases. Fig. 4—Cooled by outside water spray, a transformer can carry amazingly high overloads without danger to equipment

rated capacity without exceeding a 50-C temperature rise by thermometer.

Certain circumstances may make it safe to exceed the nameplate rating of the generator or motor. First is low ambient temperature. How much this increase can be depends upon conditions. An approximate rule is to increase the load on the machine until the temperature rise equals the standard rise plus 50% of the difference between 40 C and the actual ambient. For example, if the ambient is 30 C and rated temperature rise 50 C, then the temperature rise at 30 C can be $50 + (10 \times 0.5) = 55$ C. Machines supplying fluctuating loads can be overloaded during short periods without exceeding permissible temperature, if at other times they are underloaded.

Occasions will arise in war industries where long life of electrical equipment must be deliberately sacrified to keep production moving when power capacity is inadequate. At such times so-called safe maximum temperature limits can be exceeded by as much as 10 C for several weeks if absolutely necessary without producing immediate danger of failure, but with probability of some permanent damage.

Occasionally top temperature will not be the only factor limiting load. Sometimes insulations fail (particularly on long turbine-generator rotors) by the thermal expansion and contraction of the coils. Here the important factor is the temperature range and the frequency of temperature reversal. No general rules can be given here; consult the manufacturer.

When reading coil temperatures, beware of surface indications. The insulation will fail first in the coil where the copper temperatures are highest. The manufacturer can usually tell you what temperature will be dangerous at some point where you can conveniently apply a thermometer.

Cooling Builds Capacity

When the machine's temperature limit is reached, and still more capacity is needed, the only solution is artificial cooling. One practical expedient (with a self-cooled unit) lies in rigging ventilating fans to cool the machine, as shown in Fig. 1. With the ventilation in operation the thermometer in the windings will show when new and higher safe-load limit is reached.

Sometimes the rooms housing generators or motors get hot, particularly in summer, reducing the safe capacity of these units. The obvious cure is to use a fan to carry outside air directly to the machine (be sure to protect against dirt and moisture). One firm uses process water in coils to cool ventilating air by 20 F, thus permitting much higher summer loads on the motor-generator sets.

In large units cooled by closed-system circulation, generator capacity can be increased by using cooler water in the coils—for example by using cold raw water instead of condensate, at some sacrifice in the plant heat cycle. Capacity of large hydrogen-cooled generators can be increased substantially by raising hydrogen pressure.

Can Turbine Handle Generator?

If the generator has a safe kva limit it must be remembered that the driving turbine has a kilowatt limit based not on safety but on the mere ability of the turbine to pass enough steam. Thus, if the turbine can barely carry the generator at nameplate kilowatts and 80% power factor, any power-factor improvement above this will not permit higher load on the unit. In most cases the turbine can supply more mechanical power than is needed to produce the rated generator kilowatts.

In that case, any increase in power factor above that of the generator nameplate permits a corresponding increase in kilowatt capacity of the unit. Thus an increase from 0.8 to 0.9 pf converts an 800-kw unit to 900 kw if the turbine end is ample.

Improved power factor at the load

centers increases the effective capacity of the generating unit, reduces kva load on transformers and feeders and is equivalent to an increase in capacity all along the line.

Temperature is the usual test for safe loading of transformers. If there are no indicators in the winding use the oil temperature as a fair guide. In general, the oil temperature should not exceed 150 F. While oil temperature is a reasonable guide in most cases, it may mislead if the load is suddenly increased so that the insulations heats excessively faster than the oil. Ask the manufacturer for rules regarding oil temperature, or get a copy of the new proposed American Standards for Transformers, Regulators, and Reactors of the American Standards Association.

In most cases a self-cooled oil-insulated transformer can be overloaded 100% for perhaps an hour without exceeding a safe temperature limit. Clean oil and windings are important. With sludged windings copper temperature may be dangerously above oil temperature.

In self-cooled transformers remember that greater loads can be carried when the air is cool. The same holds for water in water-cooled units. It is safe to carry a steady overload on transformers wherever the daily average temperature of the cooling air is below 30 C (86 F) in the case of oil-immersed, self-cooled transformers, or the temperature of the cooling water below 25 C, (77 F) in the case of oil-immersed water-cooled units. Allow 1% safe overload for each degree C below the specified temperature, but don't exceed 30% overload for self-cooled units or 25% for water-cooled. A heavy blast of air or a water spray will greatly increase the emergency capacity of an air-cooled transformer. Fig. 4 shows how water was sprayed over two transformers to reduce their oil temperature from 194 F to 122 F.

The temperature of a loaded cable is not simply a matter of resistance and current. Heat produced must be dissipated and any increased resistance to heat dispersion necessarily increases temperature. Removing one or two conductors from the center of a bank will increase capacity of the bank if a fan is applied to force air through the space created. (see Fig 3).

Capacitors to increase power factor form another cure for hot cables. One plant raised pf from 0.7 to 0.9 and thereby decreased cable load 23%. Cables in ducts in hot power-plant concrete floors are particularly liable to overheating. Search out these hot places as potential troublemakers. Sometimes it will pay to pull the cables out of their ducts and run them in the open.

Low voltage at the end of long distribution lines is a self-aggravating condition. With undervoltage the motor draws additional current to carry the load and this in turn causes still further line drop. Possible cures are transformer taps to correct the low voltage, a voltage regulator, or transformers to boost the voltage at the load centers.

Cure for Dropping Voltage

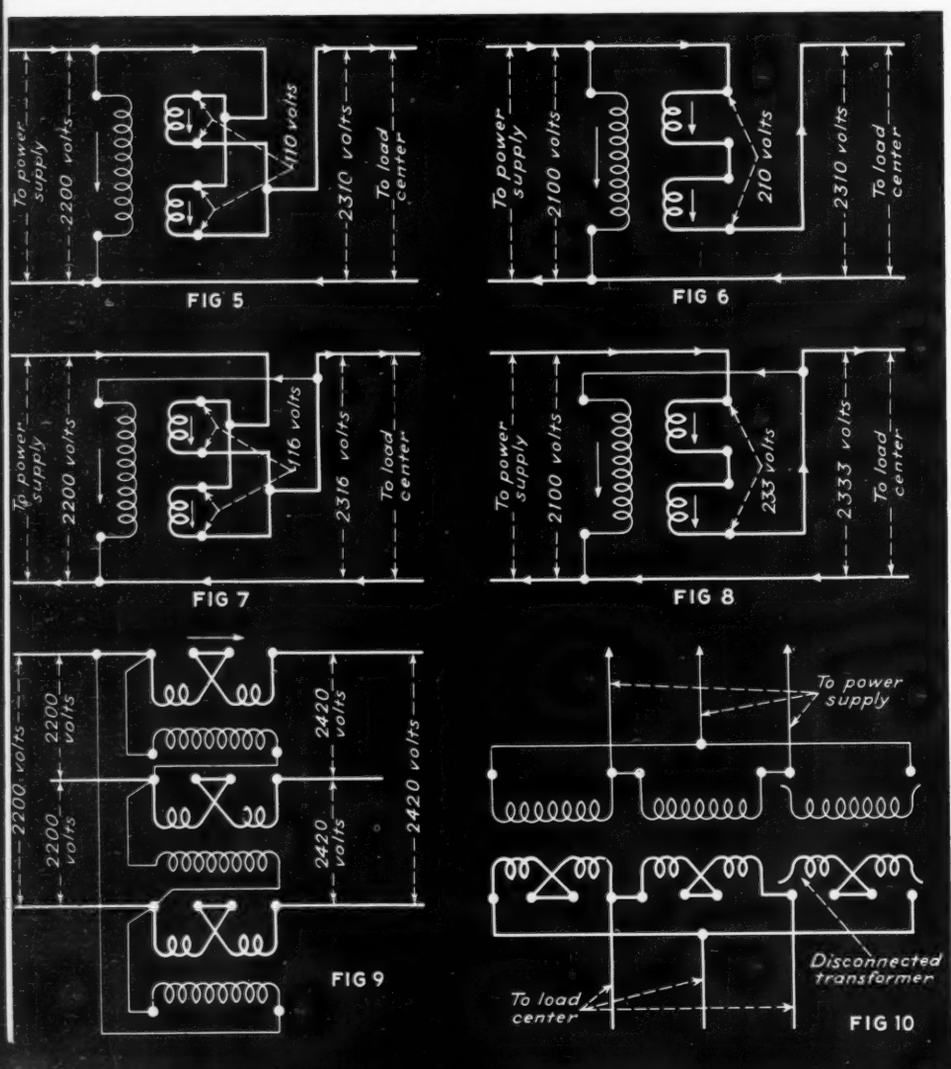
Figs. 5 to 8 show how the low- and high-voltage leads of ordinary distribution transformers may be grouped to boost voltage to four different values, by suitable combinations of the two high- and four low-voltage taps. Fig. 5 shows the connection for a 5% boost and Fig. 6 for a 10% boost. Fig. 7 is the same as Fig. 5 except that the primary winding is connected to the boosted voltage, giving 2316 volts, an increase of 5.2% over 2200 volts. In Fig. 8 connection of the primary winding to the boosted voltage gives an increase of 11.1%. Fig. 9 shows three transformers connected to boost the voltage of a 3-phase line.

For boosting, the low-voltage windings of the transformer must be able to carry the line current, unless connected as in Fig. 5, where each section carries only one-half of the line current. Since the low-voltage windings of the booster transformers are connected to the high voltage, they must be insulated from ground and guarded so that no one can contact live units.

These transformers are so connected to the line that they act as series units. The high-voltage winding must not be opened when the low-voltage winding is alive. This excludes the use of load protection on these transformers.

Fig. 10 shows one way to make two transformers do the work of three when an emergency requires the removal of one transformer for repair. This connection is the "open delta", same as the original closed delta except that in this case the right hand transformer has been disconnected without disturbing any other connections. The remaining two are theoretically good for 58% of the safe load of the original three, but the two can generally carry the peak loads with the aid of forced air cooling or water spray (as in Fig. 4).

Fig. 5–8—These trick transformer connections boost line voltage (see text). Fig. 9—Three transformers connected to boost voltage of a 3-phase line. Fig. 10—If one transformer fails in a delta-delta bank it can be cut out this way and at least part of the load carried on the other two units, without change of connections



Fighting Power-Plant Fires – III

D B Smith Co Photo

War conditions focus attention on the familiar hazards of electrical fires and the new and strange problems of incendiaries. W E Rossnagel concludes his series with practical suggestions for extinguishing class C and special fires

► Two parts of electrical apparatus which are inflammable are wire insulation and insulating oil. Were it not for the electrical hazard, the burning insulation might be treated as a class A fire and the oil as a class B fire. Safety to men and equipment demands that all electrical apparatus should be considered alive, presenting a different problem. The extinguishing agent must, therefore, be a non-conductor. Among these are carbon dioxide, carbon tetrachloride, and atomized water. In the first article of this series, a table was included giving the relative conductivities of extinguishing liquids unsafe for use on live conductors (see Power, November, 1941, pg 77).

In electrical-gallery standpipe systems it is customary to keep hose on a rack detached from the water valve. This delays a man from hastily applying a hose stream to the fire before the current is shut off, and gives cool-headed men an opportunity to arrive on the scene and prevent the hasty application of water. It is desirable, although it should not be necessary, to attach metal warning tags to the standpipe valve. Such tags might read "Do not use water until current is shut off."

Spray pipes within the casing of large generators supply water to extinguish fires in the armature and field windings. The pipes terminate in a valve outside the generator housing where a short hose is connected to the water supply. A box of suitable size to inclose the end of the dry pipe, folded hose, and a spanner wrench is kept locked and can only be opened by breaking a small glass window to unlatch the door. This prevents unauthorized tampering and guards against water leaking into the generator.

Turbine rooms require an adequate number of vaporizing-liquid extinguishers placed at strategic locations around the room where they may be arranged in groups on small 4-wheel hand trucks for quick transportation. These trucks should also contain all-service canister gas masks for use if carbon tetrachloride fumes become objectionable or dangerous.

In pump rooms, elevator penthouses, and in other places where motors or switching equipment are located, vaporizing liquid or CO_2 extinguishers of appropriate size should be provided.

Large oil-filled transformers are frequently placed over pits or have concrete dikes built to retain the oil if a

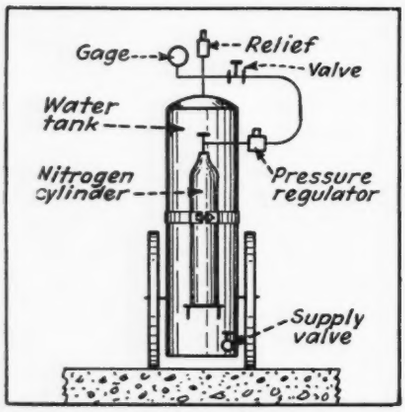


Fig. 2—Design of a small portable pressure water supply for a spray nozzle play pipe effective on oil fires

serious fire or leak develops. For indoor installations, many plants use fixed CO_2 systems. A battery of cylinders connected to a manifold is located outside the danger zone and piped to a number of nozzles. These are strategically placed to direct discharge into the pit or toward the expected flame source. Gas-cylinder control valves are connected in tandem and operated by a pull wire or chain at a convenient location remote from the fire. In some generating stations CO_2 from a battery of cylinders is piped directly to the generator casing and controlled by a remote-control quick-opening valve. CO_2 is more suitable than water for generator fires because it will not affect internal parts.

Where a built-in system is unwarranted economically, provide portable apparatus in the form of a 50-lb cylinder of CO_2 mounted on wheels with the necessary hose and nozzle. Place 15-lb CO_2 extinguishers at strategic locations near all electrical apparatus.

Spray-nozzle fire equipment discharges finely atomized water which forms an emulsion with the oil particles or forms a blanket of thick fog over the fire. Simple and effective emulsification converts an inflammable liquid into one which cannot burn. The aqueous oil emulsion consists of a great number of exceedingly tiny oil globules, each surrounded by a water film. The surface of the emulsion is coated with a thin sheet of water.

Emulsion forms at the oil surface almost instantaneously, extinguishing fires within a few seconds from the time water flows. Water sprayed on a fire in a finely atomized state is turned to steam by the heat, reducing oxygen content around the fire.

Underwriters Laboratories, Inc., has made tests to measure electrical conductivity of water issuing from one nozzle design. A screen of $\frac{3}{16}$-in. galvanized hardware cloth fastened upon a wooden frame furnished a square large enough to accommodate spray from the nozzle at the position of greatest dispersion. An adjustable wooden frame supported the nozzle. Ammeters were connected directly between the nozzle and the grounded end of the transformer secondary, which supplied the high voltage. Current measured was the maximum possible for test conditions. Other than the stream itself, there were no current-limiting elements in the circuit. Current readings were made at various voltages and with different water pressures at the nozzle, as well as different distances between nozzle and screen.

With this setup and with the particular nozzle tested, results showed that the nozzle may be safely employed at distances over 10 ft from electrically charged objects at 60-cycle voltages up to 250,000. These tests also showed that the clearance flow characteristics of the stream from spray nozzles depend to a large extent upon the stream produced and the manner in which the water is broken up. It should not, therefore, be assumed that all spray nozzles will produce streams having such low current-flow characteristics as the nozzle tested.

Water Resistivity

Water used for these tests had a resistivity of 2150 ohms per cubic centimeter. It is generally understood that a 60-cycle current of one milliampere can just be felt; currents of 4 to 10 milliamperes, depending upon the individual, will cause a sense of pain; a 30-milliampere current can cause unconsciousness; and a current of 100 milliamperes is dangerous and can be fatal. Information on the conductivity of any type of spray nozzle can be secured by writing to its manufacturer.

This system is suitable for class C fires, particularly those in which oil is burning. Fog or spray nozzles are often permanently mounted at carefully chosen positions above and at the sides of oil-cooled transformers for oil switches and directed toward the possible source of the blaze. Water control may be automatic or manual.

Where the fixed system of spray piping is not desirable, a portable apparatus, shown in Fig. 2, may be used. This consists of a 25 cu ft cylinder of nitrogen under a pressure of 2000 psi, a 25-gal tank containing water and 50 ft of hose with a nozzle, total weight being about 400 lb. Nitrogen, admitted through a 75-lb pressure-reducing valve, enters the top of the tank, forcing the water through the hose and nozzle.

Fig. 3—Spray nozzle equipment permanently installed provides fire protection for large power transformers

Grinnell Company Photo

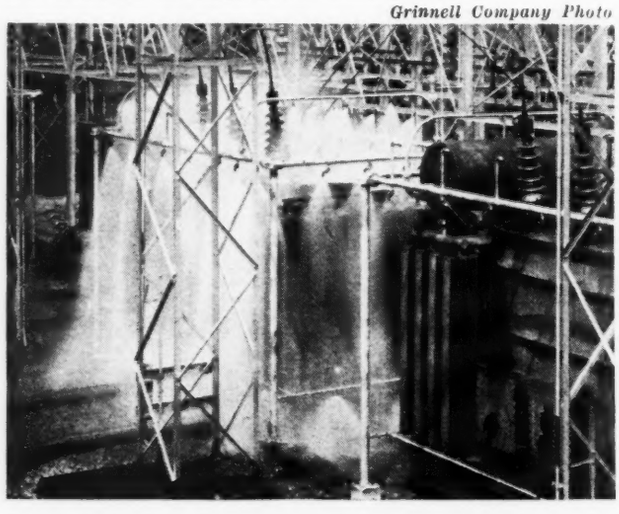
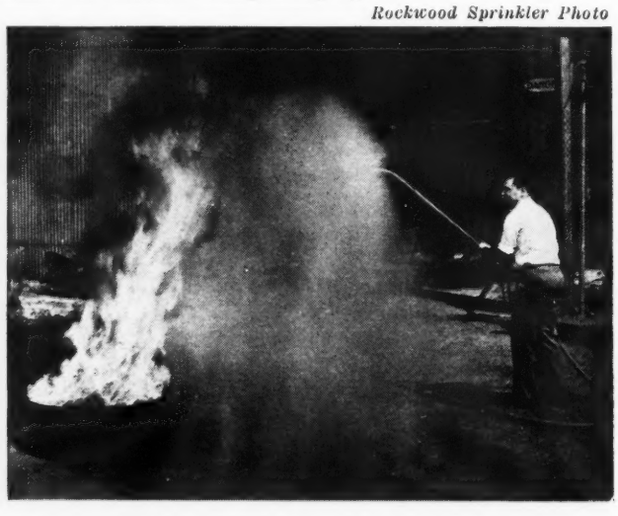


Fig. 4—Water atomized to fog by a properly designed nozzle makes an effective extinguishing agent

Rockwood Sprinkler Photo



Elkhart Brass Photo

Fig. 5—Discharge from an adjustable spray nozzle forms a protecting curtain permitting firemen to approach within working distance of the fire

In a recent test on an oil-switch compartment, transil oil heated to 300 F was spilled over the oil switch and on the floor. This oil was ignited and allowed to burn for five minutes. The portable spray equipment was applied to the fire and within four seconds after the valve was opened, the fire was out. Since the discharge from the nozzle is 15 gpm, the actual water used to extinguish the fire was one gallon.

Special Fires

Tests have also been made on the conductivity of fog directed at a live busbar at 20,000 volts. With the nozzle 3½ in. from the bus, the current recorded was 3 milliamperes; at 7 in., 0.25 milliamperes, and at 10 in. the pointer movement on the instrument was imperceptible. Authorities on the subject, however, agree that a grounding cable should be attached to the applicator and properly secured to a ground bus before water is turned on.

In power-plant operation, there are some special fire hazards to be met. For instance, soft coal suffers from spontaneous combustion in the bunker or storage pile. If the supply of coal in the bunker is low, it may be possible to withdraw heavily from the affected section so that the burning coal will be delivered to the furnace. If the fire is near the surface, water from a fire hose can be used, but if it is deeper in the pile, small pipes must be driven into the coal through which saturated steam can be discharged.

Pulverized-coal storage bins, dryers, and coal-dust conveyor ducts should have connections for steam admission. Steam will smother fire quicker than water without unduly wetting the coal which might clog.

Bad fires have been known to occur in air filters of fans ventilating electrical apparatus. These filters usually consist of steel frames containing steel wool saturated with oil to catch and hold minute dust particles. When such a filter catches fire, the draft of air causes it to burn fiercely and flames may be carried through the ducts to the transformer or other equipment. It is essential that the fan be shut down at once; then a stream from a hose or a soda-acid extinguisher may be directed on the blaze. Carbon tetrachloride should never be used on this particular type of fire as it aggravates rather than extinguishes.

Now that incendiary bombs can be included among the possible causes of fires in power plants, effective means of extinguishing must be provided. A common type of bomb has a magnesium shell containing powdered aluminum and iron oxide, together with a priming device. This combination of materials is known commercially as thermit. When heated efficiently, the aluminum unites with the oxygen from the iron oxide, producing molten iron at about 5000 F which ignites the magnesium shell and other combustibles within reach. Dry sand is effective in preventing the spread of molten metal or sparks from a thermit bomb.

Extinguishing Methods

There are several proprietary extinguishing materials which manufacturers recommend for an incendiary bomb. A water stream applied to this type of fire aggravates the condition as it breaks down into hydrogen and oxygen which unites with the metal, burning with a hot flame and liberating intense heat.

Water in the form of a fine spray, while making the materials burn more violently, causes them to burn themselves out in a much shorter time. Thus, with the bomb itself burned out more quickly, the hose stream can be turned on other combustible materials before the fire has gained too much headway.

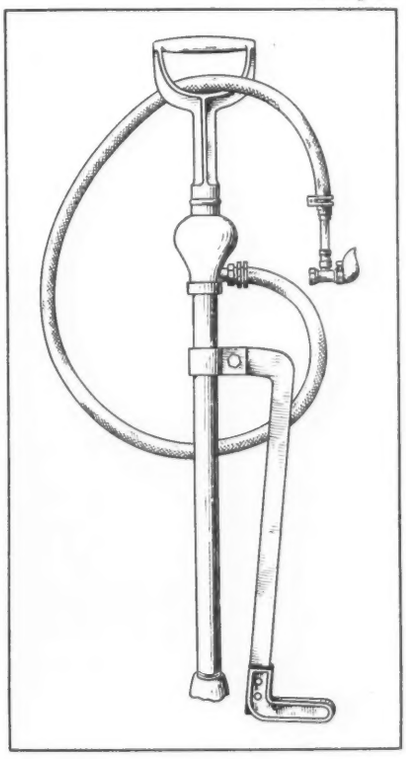
As a portable device for this purpose, the stirrup pump has been developed. This has the appearance of a common tire pump and is designed to take its suction from a 10- or 12-quart pail. Three men are required for its use, one operating the pump, another handling the hose nozzle and directing the discharge, and the third man keeping the pail filled with water. A trombone-action pump and water container that can be carried on the operator's back provides an effective device for fighting this type of fire and requires only a single operator.

Both pumps have adjustable nozzles at the end of a length of rubber hose for discharging a fine spray directed at the bomb as mentioned above, or a small solid stream for use on other burning material.

A long-handled shovel or special clamshell device covered with sand can be used to pick up the burning bomb and carry it outside the building. Where the bomb has lodged on a non-combustible floor, the sparks may be prevented from flying by covering the bomb with an asbestos blanket.

Fig. 6—The stirrup pump can be used to extinguish incendiary bombs but requires a 3-man crew for its operation

Deming Co



New Fans, More Steam, No Cinder

Relocation of breechings to accommodate new fans and cyclones not only gets more steaming capacity from stoker-fired units but permits collection of 8400-Btu-per-lb cinder

By JOHN E WATSON
Prat-Daniel Corp

▶ OLDER PLANTS in congested business locations that will have to operate at high ratings to carry increased war loads can profit from the experience of a utility plant where new fans added about ½ in. water gage to natural-draft stacks. Excessive stack emission was avoided by selecting dust-collecting fans that recirculate part of the flue gas and remove cinder by cyclones.

As in many existing plants, no convenient location for new induced-draft fans with conventional cinder-collecting equipment was available below roof level. The old stack breeching occupied practically the entire space between boiler outlets and roof.

To make space for properly housing fans and their motors within the enclosed part of the boiler house, breechings were raised well above the roof level and fans arranged to discharge vertically upward. Cyclones, necessary auxiliary to the skimmer-type fans, are located alongside the new breeching. From this level, collected cinder discharges by gravity into an inclosed bin in the stack base from which it eventually feeds into the furnace where part of its 8400 Btu per lb is recovered.

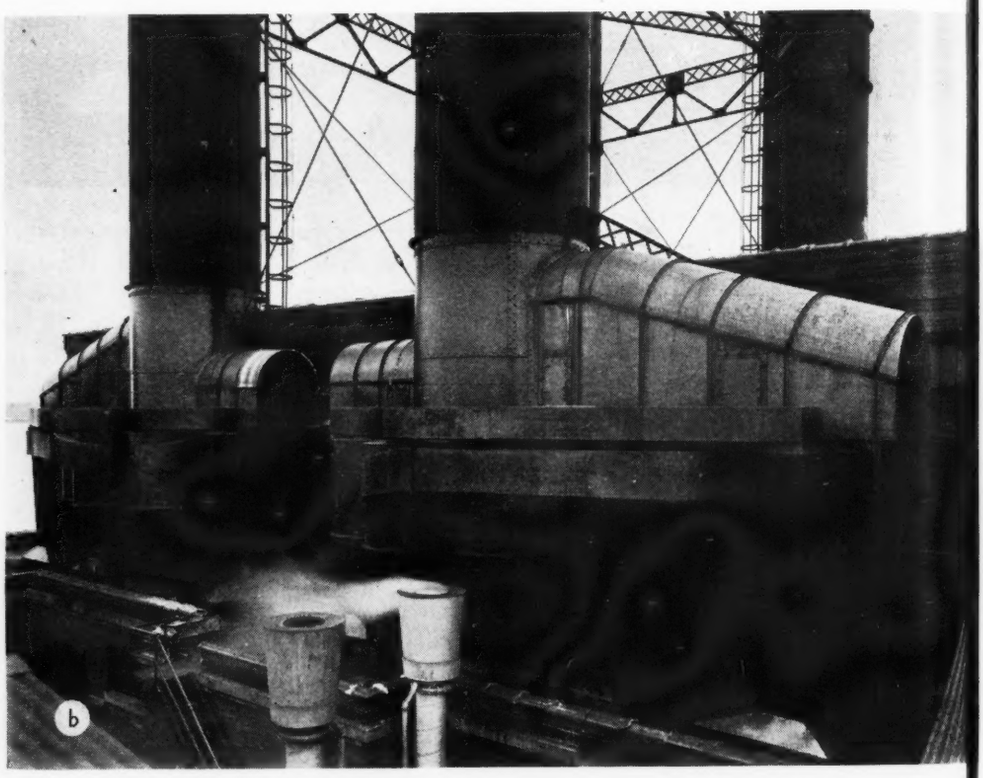


Fig. 1—Old breeching below roof level has been completely removed to provide space within structure for cinder-collecting fans. Storage bin in stack base piped to fuel bed for burning cinders.

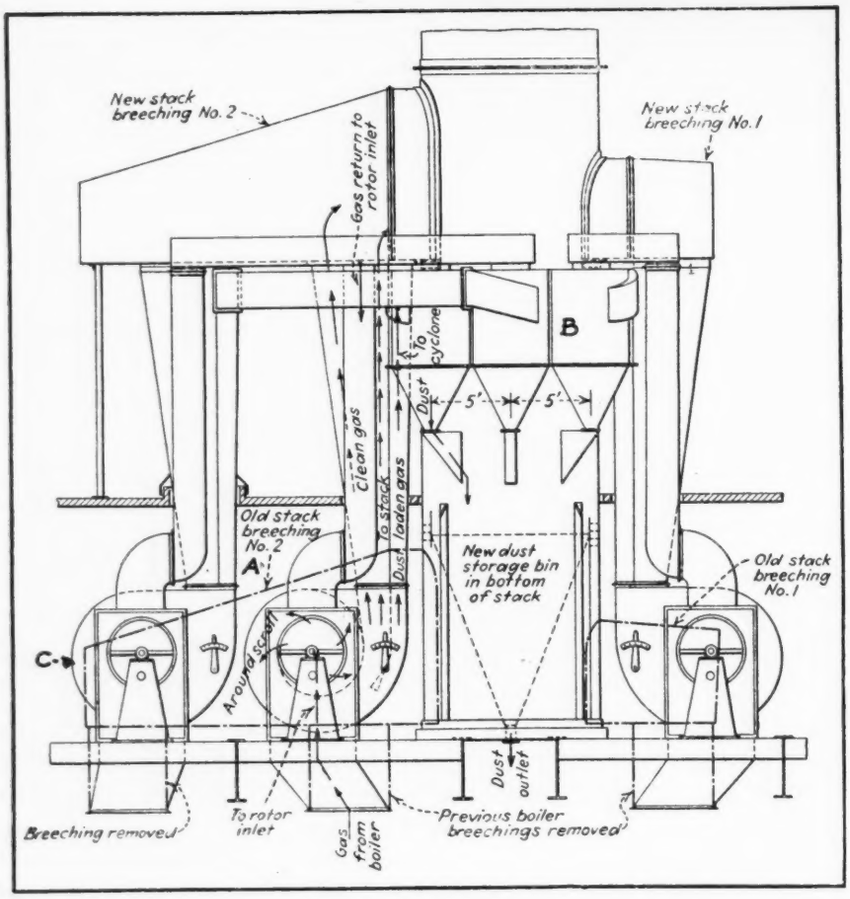


Fig. 2—New breeching enters stack at a point well above roof level. Small cyclones separate cinder from skimmed portion of flue gas

Gas leaving the boiler enters at each end of the fan wheel; cinders thrown by centrifugal force into the outer part of the scroll pass through a damper-controlled skimmer outlet to the cyclones. From 10 to 20% of the flue gas bypasses back to the fan inlet. About 1.6% of the coal fired, by weight, was returned during a test period.

By this common-sense combination of induced-draft fan and cinder collection equipment, twelve 7000-sq-ft boilers now can run at 300% rating without contributing to community dust nuisance.

THE OPERATING ENGINEER

George Edwards
Advisory Editor

PRACTICAL AIDS · MAINTENANCE HINTS · QUESTIONS—ANSWERS

PUBLISHED MONTHLY AS AN INTEGRAL PART OF POWER

How to Inspect a Diesel Engine

Sound maintenance, more important than ever today, depends on thorough periodic inspection of engine condition and alignment. E. R. Spencer continues with the practical step-by-step checking procedure begun in the March issue

▶ HAVING COMPLETED INSPECTION of the crankshaft and main bearings (see POWER, March, pg 94), the operator should now turn his attention to the cylinder or liner. Examine each liner for cracks, scores, or other defects that would make it unfit for service.

Measure the diameter of each liner with inside micrometers in several places near the rubber grommet or other water-jacket seal rings. Often these rings will force the liner out of round. If, after considering possible wear, the liner is more than 0.0002 in. per inch of diameter out of round, the condition should be corrected.

A complete record of liner wear makes it possible to predict future performance and to set up an intelligent maintenance program. Therefore, each liner should be measured accurately with inside micrometers and a permanent record made of the results. It is customary to take these measurements across the liner in planes parallel and perpendicular to the crankpin. The number of measurements taken depends on how elaborate a record is desired. For a complete picture of liner wear, the following schedule is recommended.

Take measurements at the center of each compression-ring location when the ring is in extreme top position. Take four additional measurements between the lower compression ring position and the bottom of the liner. Make the first of these one-tenth the distance from the center of the bottom compression ring in its top position to the extreme lower end of the liner. Take the next two at one-quarter and six-tenths this distance, respectively. Make the fourth measurement across the liner at the extreme bottom. If the engine operates on the 2-stroke cycle, the operator should obtain at least one measurement near the center of the port zone. These may be in addition to the measurements specified above.

If the records thus obtained are to be of future value, they must be taken in such a way that measurements in identical places can be made at a later date for comparison. A template will insure the necessary accuracy. Make it from ⅛x1-in. strap iron or copper. Near one end make a right-angle bend that will hook over the top of the liner. Accurately locate the position of each liner measurement desired along the length of the template. At each location, drill a hole slightly larger than the inside-micrometer shaft. Scribe the top of the liner so that the template can always be returned to the same position with respect to the crankpin center line.

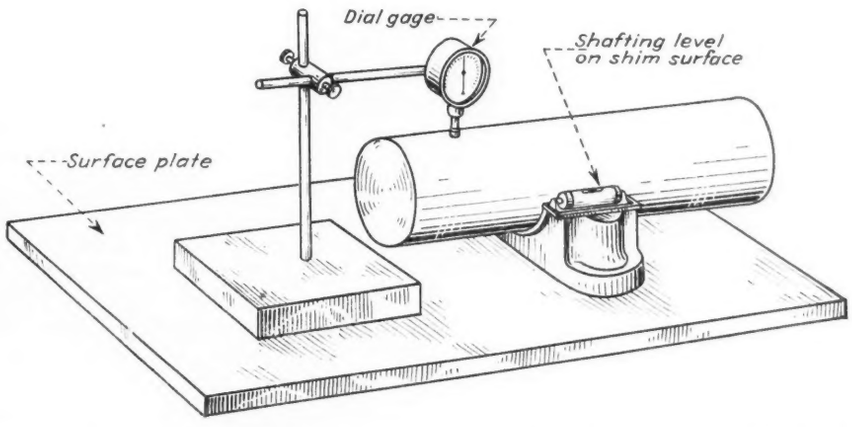
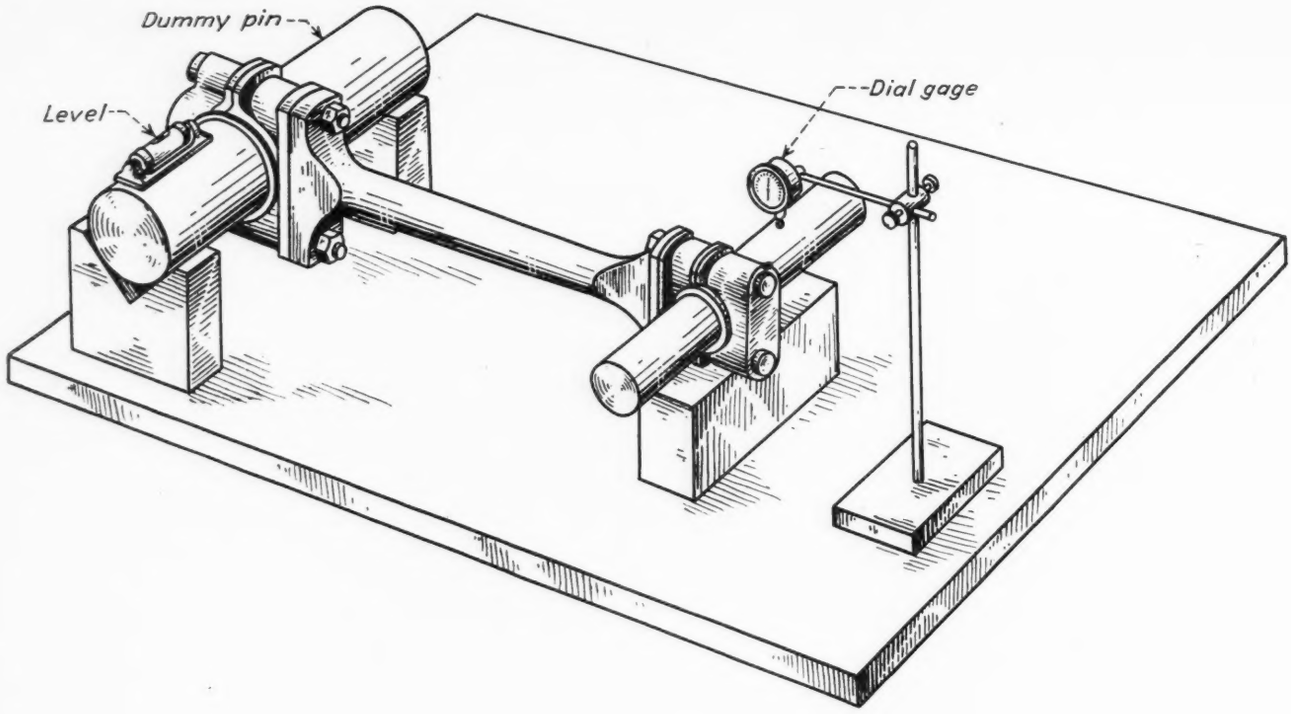


Fig. 1—Checking bearing-shell bore requires surface plate, dial gage and shafting level

Measuring Liner Wear

There has been no uniform way to express liner wear. Hence the operator has been unable to compare his figures with the experience of others. To put these measurements on a comparable basis, the following is suggested: *Maximum liner wear*—the difference between the largest diameter found and the original liner diameter. *Liner wear*—the difference between the original liner diameter and the numerical average of the diameters perpendicular and parallel to the crankpin, at the center of the top compression ring in its extreme top position. *Out-of-round liner wear*—maximum liner wear minus the smallest diameter measured at the same height as the maximum liner wear.

It is difficult to say just when a given liner is no longer serviceable. Many



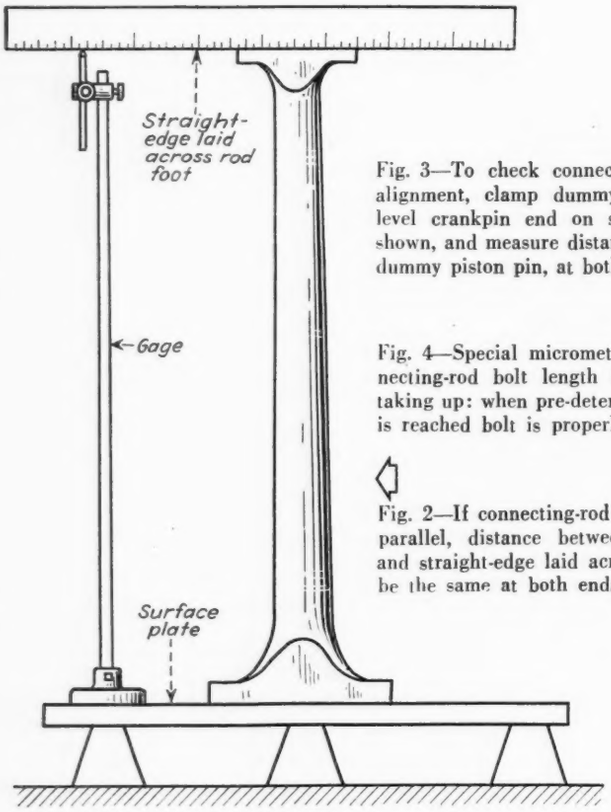
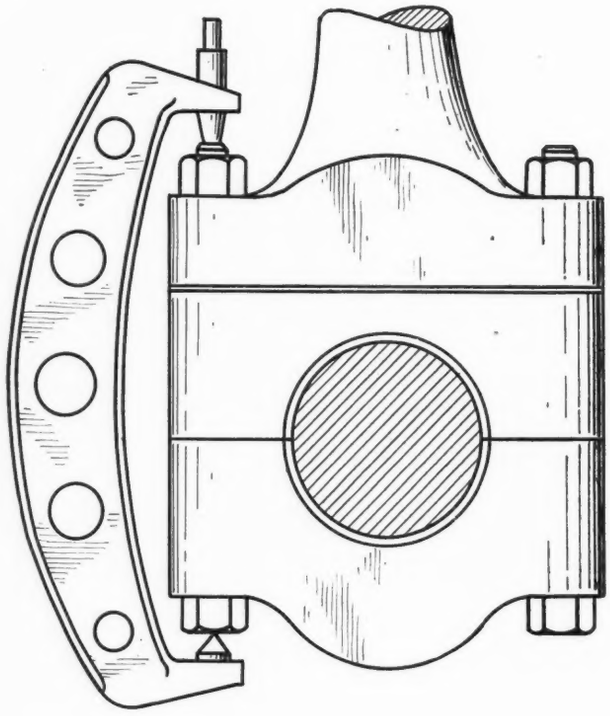


Fig. 3—To check connecting-rod-assembly alignment, clamp dummy pins in place, level crankpin end on surface plate, as shown, and measure distance from plate to dummy piston pin, at both ends

Fig. 4—Special micrometer measures connecting-rod bolt length before and after taking up: when pre-determined elongation is reached bolt is properly tightened

Fig. 2—If connecting-rod foot surfaces are parallel, distance between surface plate and straight-edge laid across rod foot will be the same at both ends



companies set a limit of 0.005 in. per inch of diameter. This is, of course, based on the assumption that there are no unusual tapers or out-of-round conditions.

Remove inspection plate from water jacket and examine for scale. Check near top of liner with extra care because high temperature makes this part susceptible to scale formation.

There are so many types of piston pins, piston-pin bearings, connecting rods and crankpin bearings that it is difficult to set up an inspection procedure that will cover all. However, in any case the clearance between moving parts should be determined. If the piston-pin bearing is adjustable, the matter of compensating for wear is simple. If it is a bushing in the rod or in the piston, replacement is required. The amount of clearance recommended for piston-pin bearings fluctuates between wide limits. For quiet operation this value varies from approximately 0.00025 in. per in. of diameter for babbitt bearings to 0.0008 in. for bearings of high-lead bronze. Condition of the pins should be checked for flats or out-of-round, scores, or evidence of excessive wear.

To illustrate procedure, assume alignment of a connecting rod with

marine piston-pin and crankpin bearings is to be checked. This requires a surface plate, dummy pins or mandrels, micrometers or dial gages and a shafting level. With this bearing, the bore will be checked in the same manner on both crankpin and piston-pin bearings. Place the flat surfaces of the bearing shell on a surface plate, Fig. 1. With a thin feeler gage (0.0015 in.) check for warp, rough spots, or uneven surfaces. When any troubles found have been corrected and the bearing sets flat on the surface plate, place a level on the shim surface. This should have the same slope as the surface plate. Now place the dummy pin in position and measure from each end of the pin to the surface plate with a dial gage. If the bore of the bearing parallels the rod-foot pad or flat surface, these measurements will be the same. Extreme care should be taken to keep these misalignments as near zero as possible. While making this particular inspection, it may be desirable to use blueing on the mandrel to determine the condition of the half-bearing surface.

The next logical step in checking the connecting-rod assembly is to see that surfaces of both connecting-rod feet are smooth and true. To do this, set the rod in a vertical position on the plate and check for openings between plate and foot face. Repeat this procedure on both ends of the rod. Now lay rod in horizontal position and level the crank-end foot. In this position, the piston-pin-bearing foot should also be level. This check is based on the assumption that bearing-bolt holes through the feet are symmetrical. If there is any doubt about symmetry, insert the fitted bolts and make level readings from the top of them. Any misalignment, in any direction, must be corrected before making further investigation.

The rod feet must also be parallel to each other in a plane parallel to the piston and crankpins. Determine this by placing the rod in a vertical position with the crankpin foot resting on the surface plate. If the foot surfaces are in alignment, the distance from the surface plate to a straight edge laid across the piston foot will be the same on both sides of the rod, Fig. 2.

With all discrepancies corrected, assemble the rod and bearings, leaving out the shims. Tighten bearing bolts sufficiently to clamp dummy pins in place; that is, so the crankpin dummy fits squarely in the upper half of the crankpin box and the piston-pin dummy lays flat in the lower half of the piston-pin box. With these in place level the crankpin dummy, Fig. 3. If the bearings have been bored accurately, the piston-pin mandrel will be level also. Any misalignment found usually can be corrected by properly scraping the bearing. While the parts are thus assembled, make a check on previous measurements. With inside micrometers measure the distance between dummy pins on each side of the rod. If these are the same, it may be assumed that the previous steps have produced a well-aligned assembly. Remove mandrels and assemble piston-pin bearings with proper clearance. Tighten bolts as later recommended for connecting-rod bearing bolts.

The above instructions will not apply to all connecting-rod assemblies but application of the general principles will produce satisfactory results.

The operator should now check the piston for wear and mechanical defects. Inspect each piston-ring groove for rough and worn ring seats. Determine the ring-groove width with conventional adjustable plugs, gage and outside micrometer, or with regular plug gage and graduated feelers. With outside micrometer, measure the piston-skirt diameter both perpendicular and parallel to the piston-pin. On the usual trunk piston, these two measurements should not differ more than 0.0003 in. per inch of diameter. Compare the piston skirt diameter with minimum liner diameter. The permissible clearance will vary with design and must be determined for each case.

The piston and connecting rod can now be assembled and lowered into place. Assuming that the crankpin bearing has already been inspected and fitted, it only remains to be adjusted to the crankpin. Assemble the bearing in place with the original shims. Place lead wires in the bearing cap as previously described for the main bearings (POWER, March, pg 96). With the original clearance thus obtained, remove sufficient shims to insure desired clearance when the bearing bolts are properly tightened.

Tightening of connecting-rod bolts has been the subject of much discussion in recent years. Some engine operators still recommend use of "cheaters" or sledges to place the bolts in proper tension. The dangers in this practice cannot be stressed too strongly. Others prefer to use shear or torque wrenches, which is a step in the right direction.

Perhaps the most satisfactory method of tightening these important bolts is by accurate measurement. The following procedure is recommended. First assemble the bearing in the usual manner. Run the nuts down on the bolts just hand tight. Measure the length of each bolt with a micrometer. Now tighten the bolts until further measurements indicate a pre-determined amount of elongation. Proper elongation varies with the size and type of engine and depends on length and cross-section of bolt, inertia forces, and allowable unit stress.

To facilitate tightening of bolts by this method, provide them with button-head studs on each end for measuring anvils. A specially designed shallow-frame micrometer also helps to make the job easier and more accurate, Fig. 4.

Ten Rules for Safe Air-Compressor Operation

1. Avoid excessive lubrication; oil carried over to receiver may vaporize and, with the hot air, explode if it comes in contact with a spark or hot surface.
2. Install a fusible plug of proper design between the compressor and receiver to keep air temperature below the point at which oil will ignite
3. Pistons, cylinder heads, and particularly delivery valves and valve chambers should be kept free from accumulated deposits
4. Provide an air filter to remove impurities from intake air; filter should be constructed to permit easy servicing and should be kept clean at all times
5. Place a suitable oil trap with a discharge cock at the lowest practical point in the piping between air compressor and receiver
6. Avoid pockets in air lines where oil and grease can collect; if they can't be avoided, provide for suitable draining and blow-through
7. Blow bottom drain cock of each receiver at least once each shift in order to remove any grease and water from the system
8. Provide a thermometer well and thermometer in piping between compressor and receiver and read temperature at least twice a day. At the same time observe temperature and rate of flow of cooling water
9. Immediately investigate any undue rise in compressed-air temperature or increase in oil consumption and cure the trouble as soon as located
10. Open and thoroughly examine all air receivers at least once every two years and remove all grease

Ways to Save Welding
ELECTRODES
for War Production

Millions of pounds of precious electrode metal, essential to wartime operations, can be saved by sound welding technique, plus horse sense; Clayton B Herrick, Lincoln Electric Co welding engineer, tells how

▶ THE NATIONAL NEED TO conserve materials (particularly metals and alloys) for the war effort, is reaching an acute stage. Welding is a key process in the high-speed production of warships, military planes, tanks and a great variety of other war equipment. Such uses are today consuming thousands of tons of high-quality welding electrodes. Always a matter of good business, the efficient use of electrodes and electrode metals now becomes a matter of patriotism as well. Electrodes must be made to do a 100% job in war production.

Here are suggestions for saving electrodes without impairing work quality. In most cases these suggestions will definitely improve quality as well.

Sixteen Ways to Save

1. *Select the right type of joint and be careful of fit-up.* Some joints take much more metal than others. It will often happen that the joint taking less metal will be as suitable, or perhaps more suitable, for the particular purpose. Close fit-up will save a lot of money and metal. For example, if deposited metal costs $1 per pound (including current and labor for two beads) the cost per running foot of joint of Tee-weld, with ¼-in. plate, will be 40 cents if the plates are well fitted. If bad fitting produces a ⅛-in. gap. the cost will be increased to 80 cents per running foot.

2. *Choose the correct electrode.* While the general-purpose electrode will produce satisfactory welds under most conditions, special electrodes may prove better for certain work. Consider physical properties required, joint, position of welding, and the condition of fit-up. Then follow the manufacturer's advice.

3. *Use an electrode that has and maintains a uniform coating.* To a large extent the coating controls the weld quality. Poor coating ruins welds and wastes electrodes.

4. *Use electrodes that provide proper physical properties.*

5. *Use fast-flowing electrodes wherever possible.* Here the saving is chiefly in time, rather than material, but time also is valuable these days.

6. *Select an electrode that keeps splatter and slag loss at a minimum.* All splatter is a waste of weld metal. Note that the splatter loss of electrodes varies, so avoid electrodes that have excessive losses.

7. *Wherever possible, use electrodes that produce flat beads.* It is a waste of electrodes to deposit more metal than is needed. Time also is wasted in removing the excess metal from the joint.

8. *Select the right size of electrode.* The largest diameter electrode that can be used effectively is the best from the standpoint of conservation. The weight saving may run up to 40%.

9. *Use long electrodes.* If the electrode is long, a given stub length is a smaller percentage of the total. Thus. the monthly waste in stubs is inversely proportional to the original length of the electrodes. For ¼-in. diameter or larger, use 18-in. length.

10. *Do not bend electrodes.* This generally unnecessary habit will waste a quarter to a third of the electrode. Use the electrode straight and get the maximum of deposited weld metal from each rod.

11. *Use proper voltage and current setting.* Incorrect settings mean excessive splatter loss or inferior weld.

12. *Follow the procedure specified for the electrode.* Accompanying each electrode manufactured are detailed specifications regarding procedures to be followed. Follow them to prevent waste and assure high-quality welding.

13. *Avoid using an excessive number of beads.* Don't use two where one will do, or three where two will do.

14. *Use electrodes down to minimum stub end.* Remember that the electrode can be used the entire length of its coated surface. Leaving any more than a minimum stub end is an obvious waste. By using care in gripping the electrode at its extreme end in the holder and burning it down to the maximum extent, the operator is rendering a patriotic service. Just ½ in. saved in a stub end means 3½% on an 18-in. length rod. An accumulation of welding stubs in one shop was sampled recently and showed an average waste of 17 percent. For the time covered this amounted to $268.

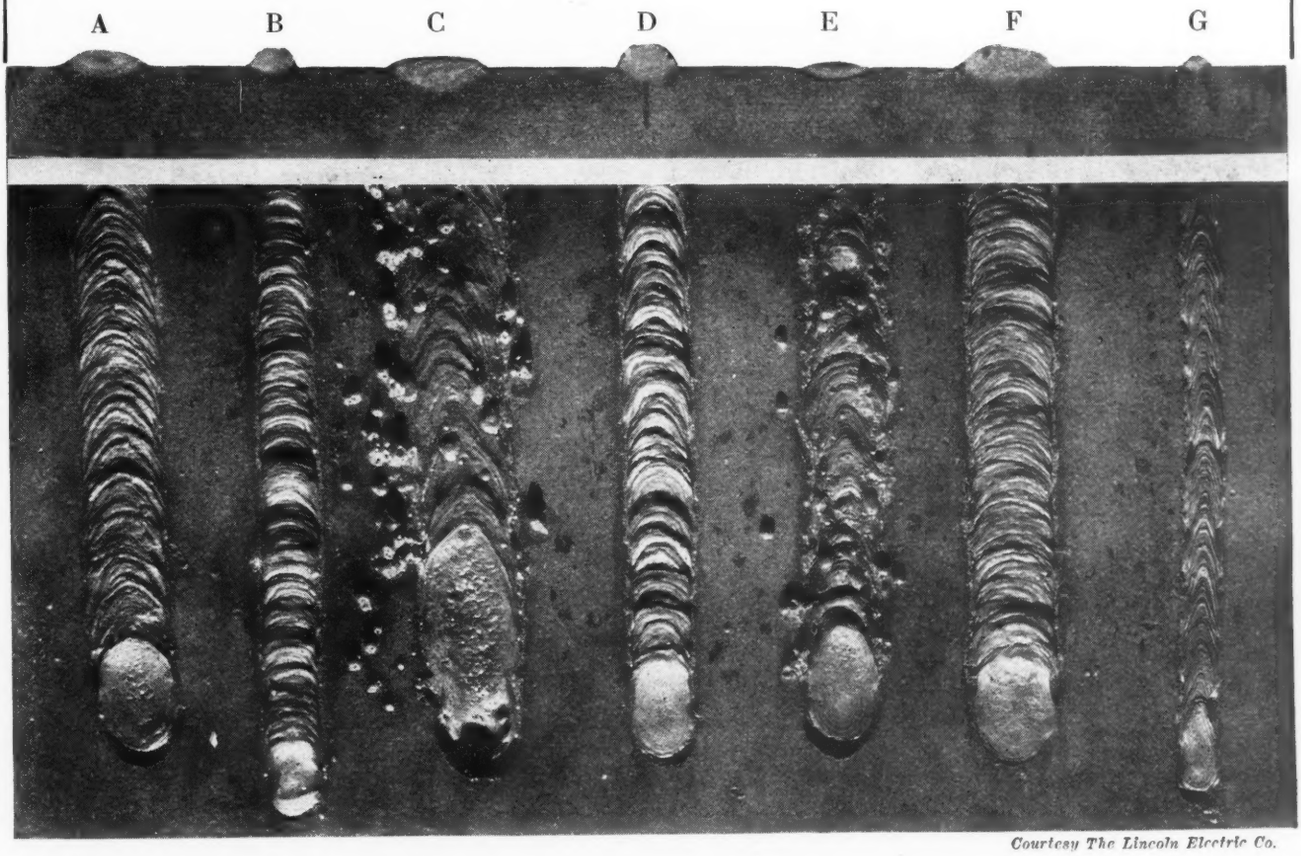
15. *Save stub ends of electrodes.* High-class scrap is precious. At the present rate of welding for war production, the metal that would be wasted by failure to save stub ends would be tremendous. The average stub end is 2 in. long. Multiplied by the millions of electrodes used, this would constitute a great loss if all were thrown away.

16. *Use modern high-capacity welding generators.* Welding generators manufactured today have much higher capacity and much greater efficiency than earlier models.

Test Your Welds With This Chart

"Arc Current," "Arc Volts" and "Arc Speed" are three factors of welding. When these are normal, as at "F," the burnoff of the electrode, penetration fusion, appearance of bead, and arc sound are as indicated. If one or more of the three factors is varied from normal the effect will indicate the cause, as shown in the table. Correct welding saves metal.

	A	B	C	D	E	F	G
Arc Current	**Normal**	Low	High	Normal	Normal	Normal	Normal
Arc Volts	**Normal**	Normal	Normal	Low	High	Normal	Normal
Arc Speed	**Normal**	Normal	Normal	Normal	Normal	Low	High
Burn Off Of Electrode	**Normal Appearance Coating Burns Evenly**	Practically Same As A	Coating Is Consumed At Irregular High Rate Watch Carefully	Coating Too Close to Crater Touches Molten Metal Resulting In Porosity	Drops At End Of Electrode Flutter And Then Drop Into Crater	Normal	Normal
Penetration Fusion (Crater)	**Fairly Deep And Well Defined**	Not Very Deep Nor Well Defined	Deep, Long Crater	Small	Wide and Rather Deep	Crater Normal	Small, Rather Well-Defined Crater
Appearance Of Bead	**Excellent Fusion—No Overlap**	On Top Of Plate, Not As Much Overlap As With Bare Rod	Broad, Thin Bead Good Fusion	High Bead Not As Pronounced As For Low Amps Somewhat Broader	Wide Spattered	Wide Bead Overlap Large. Base Metal And Bead Excessively Heated	Small Bead Undercut Reduction in Bead Size And Under Cutting Depends On Speed And Amperes
Arc Sound	**Sputtering Hiss Plus Sharp Crackling**	Irregular Sputtering, Some Crackling	Regular Explosive Sounds	Hiss Plus Steady Sputter	Soft Sound Plus Hiss And Few Crackles	Normal	Normal



Courtesy The Lincoln Electric Co.

PRACTICAL AIDS TO OPERATION

Mechanical Tester for Radiator Valves

TAKING A HINT FROM THE OLD ADAGE, "Seeing is Believing," I decided that the plumber might know more about the condition of the thermostatic radiator traps if he could see them in position. To make this possible I cut the radiator connection off one side of one of these traps and cut a similar opening in the opposite side, as in the photo. The plumber carries this unit in his tool kit and when he is in doubt about a radiator trap he removes it and places it in the inspection unit. After an inspection if the trap is considered OK it is put back into place. Otherwise it is brought to the shop where we give it a water and steam test.

New York, N. Y. P E MERIDETH

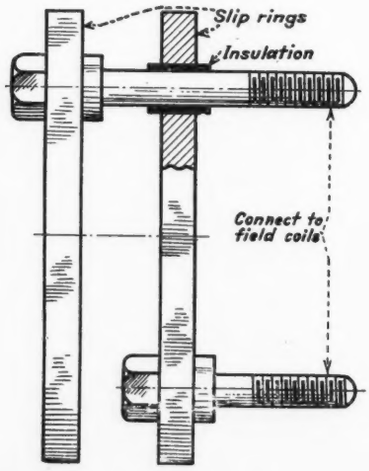
Capacitor Cuts Peak Loads

HEAVY PEAK LOADS on two diesel-engine-driven generators supplying power to an electrically driven dredge of the Washington Iron Works, Harvard, Idaho, caused unsatisfactory operation. The generators, rated 100 kw, 0.8 pf, 720 rpm, 440 volts, three phase, 60 cycles, have 3-kw, 125-volt direct-connected exciters with voltage controlled by two automatic voltage regulators.

For satisfactory operation of the dredge it was necessary that the generators produce considerably more power than their full-load rating. On heavy peak loads the exciter voltage would go up to its maximum, but was not enough to hold up the ac voltage. Frequently the magnetic switches dropped out and the dredge motors stopped because of undervoltage. The generators were being operated at about 10% overspeed, with the regulator set to give an ac voltage of about 520. Obviously, these adjustments were hard on the equipment without obtaining the desired performance. A continuous load of 210 to 215 kw with short instantaneous peaks as high as 250 kw was all that could be carried.

A 75-kva capacitor to correct the load power factor brought satisfactory operation with engine speed adjusted to normal for average load, and the regulators set to hold 480 volts. Graphic wattmeter charts showed that average loads of 230 to 240 kw could be carried for several minutes at a time, and 290-kw peak loads could be handled without trouble.

Schenectady, N. Y. C P FISHER, JR
General Electric Co



Slipring Insulation Source of Trouble

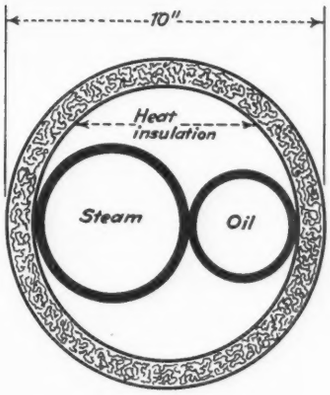
FAILURE OF SLIPRING insulation may cause some rather baffling troubles. In one case an engineer in a small generating plant reported that he could not keep the belt on an exciter driven from a pulley on the alternator shaft. A service man sent to investigate found that when the alternator was brought up to speed and the exciter voltage adjusted, closing the field switch caused the exciter belt to fly off its pulleys.

A check showed that the pulleys were in proper alignment and that the belt had sufficient tension. Tests also showed the field circuit to be free of grounds or short circuits. One of the field-coil connection studs passed through an insulated hole in one ring, as in the

figure, and was fastened to the other ring. The cause of the trouble was not apparent until it was discovered that the insulation around the stud had broken up and come out of the hole. This left the stud without any support except the nut holding it in the other ring, which was loose. When the alternator was running, centrifugal force developed by the stud was sufficient to deflect it, contact the other ring and short-circuit the exciter.

In another plant using a slipring motor on a crane, the operator found that he could not control motor speed. The trouble was also traced to faulty insulation on the studs to the sliprings. This short-circuited the slipring so that the external resistance for controlling the motor speed did not have any effect.

Plainfield, N. J. H W HODGSON



Heating Brake Oil Cures Operating Trouble

SOME YEARS AGO MY JOB INCLUDED servicing two large hoists equipped with hydraulic brakes. During the first summer after installation the brakes functioned well, but when winter temperatures came along they became more sluggish, although plenty of coal was poured into the heating plant nearby.

Our oil sump and the distribution lines were located in the basement where the temperatures averaged about 60 F. Installation of additional radiation as an experiment improved the situation a little but other means had to be tried. We then rearranged the oil pipe so that it paralleled the low-pressure steam heating line, after first removing the lagging. Then larger lagging was installed to cover both steam header and oil line, as in the diagram. Since the two lines ran parallel for 50 ft the oil was thoroughly heated and we had no more trouble with the brake.

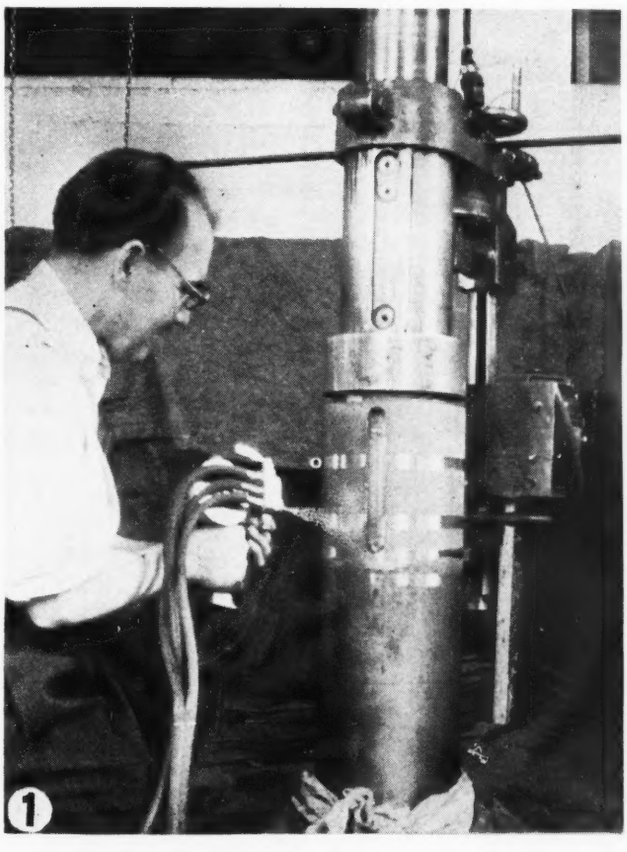
Milwaukee, Wis. P C ZIEMKE

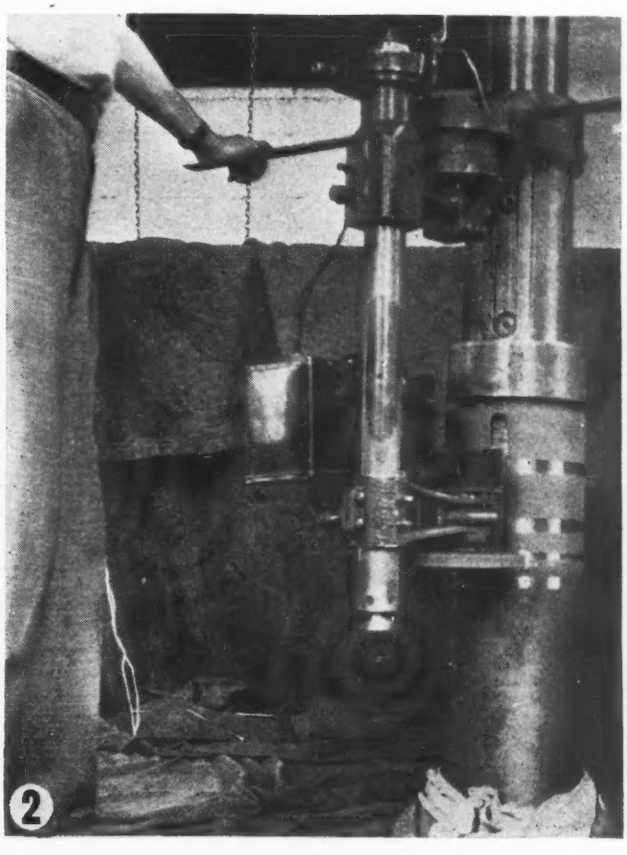
Shaft Repaired With Metal Spray

A THRUST-BEARING COLLAR became loose on the upper end of a 9-in. shaft of a 5700-hp hydroelectric generator in the East Kootenay Power Co plant, Fernie, British Columbia. This thrust collar caused excessive vibration and damaged the key and thrust-retaining ring that supported a load of nearly 18 tons. It became necessary to repair the shaft and get the unit back in operation again as quickly as possible.

A new thrust collar was in stock at the plant, but the shaft where the collar was to be located was 0.008 in. under size. To send the shaft to a machine shop 125 miles away would delay getting the unit back in service. It was therefore decided to build the shaft up by metal spraying and grind it to size. Robert Kirkpatrick of Kirk's Metallizing Shop, Edmonton, Alberta, was called in to do the job. Equipment to do the work, including the tools for grinding the shaft, was transported 450 miles.

The shaft could not be rough turned to provide a bonding surface for the

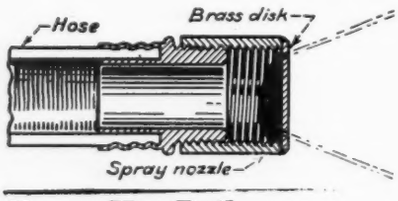




deposited metal so it was grit blasted. To prevent the grit from getting into the unit and other equipment, a platform and tent was erected around and over the shaft. Depositing the 0.1 carbon steel on the shaft was a comparatively short operation, Fig. 1, after which the shaft was ground to size, Fig. 2.

Because nearly all of the 0.008 in. worn off the shaft was on one side, during grinding, the parent metal was exposed on the unworn side without any indication of looseness of the deposit. Three days after starting the work, the bearing was ready to be reassembled. Other metal-spray repair jobs made for the power company included building up a 450-lb thrust collar, a bronze waterwheel and a stainless-steel bearing sleeve on an 8-in. shaft that runs in a lignum-vitae bearing.

Chicago, Ill. L E KUNKLER
Metallizing Company of America



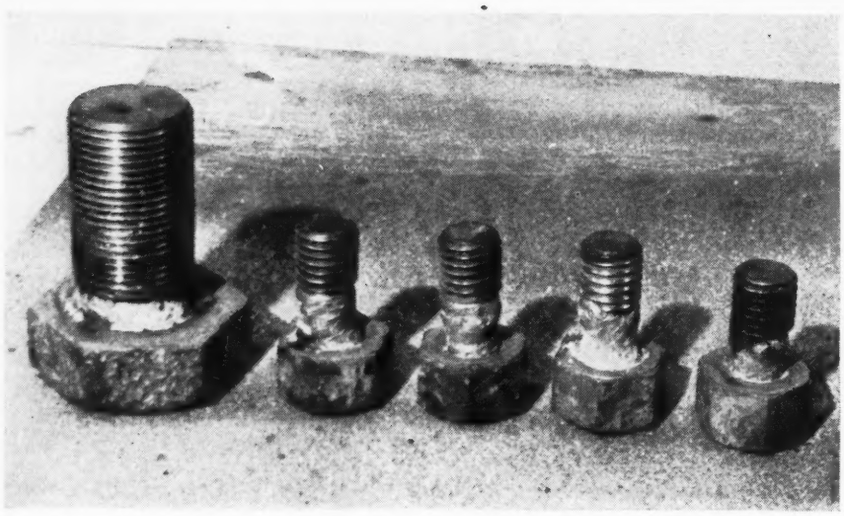
Cleans Hrt Boiler Tubes With Water

WE USED TO CLEAN THE TUBES of two hrt boilers by pushing three brushes on end through them. As every engineer knows, this is a dusty, dirty job. After a little study of the problem I discovered that water at the back of the boilers could be easily drained to a sump where waste water was pumped to the sewer. This lead to the idea that it might be possible to wash the tubes with water supplied from a hose equipped with a suitable nozzle.

To do the washing I soldered a brass disk to one end of a female hose-connector. In this disk I drilled ten $\frac{1}{8}$-in. holes at a slight angle to the axis of the hose-connector, to direct the water spray forward along the sides of the tubes, as in the figure.

To clean the tubes, the spray nozzle is pushed in the front end of a tube and the water turned on. Then the hose is slowly pushed through to the back of the boiler, then pulled out of the tube and pushed through another until the cleaning is completed. Of course it is necessary that the boiler be cool before cleaning. It is also necessary to have good drainage into a sump, but where the system can be used the result is a clean boiler.

Riverdale, N. Y. ALEX GRAY



Welding Removes Broken Studs

IN INDUSTRIAL AND POWER-PLANT WORK, the problem of removing broken threaded studs is frequently encountered. This job usually requires a machinist to drill the studs with a small drill and then with a larger one to remove as much of the stud as possible without touching the thread. After the drilling is completed the remaining thin shell is broken out with a hammer and cape chisel or other small tool.

To reduce the time required to remove broken studs two New York welders, A F Morton and W F Kramer utilize electric welding. When applying this method, a nut having an inside diameter slightly larger than the stud is placed above it. Then with the electric arc build the stud up with weld metal and weld it to the nut. The bolt then has a regular head and may be removed with an ordinary wrench.

In some cases a frozen stud will require heating the area around it to expand the metal to assist in its removal. Generally heat of the welding operation is sufficient to permit removing the stud easily. According to the welders, as many as 20 broken studs can be removed in an hour. A typical group of studs removed by this method is shown in the photo.

Cleveland, Ohio A F DAVIS
Lincoln Electric Co

Piping Increased Turbine Backpressure

WHEN STEAM PRIME MOVERS exhaust or bleed against pressures higher than those for which they are designed, an increase in steam flow to their throttles can naturally be expected. If all of the exhaust or bleed steam can be economically used in process and power demands on the unit can be met, this increase in throttle flow can be ignored. On the other hand, where part of the exhaust must be lost to atmosphere or where the demand for bleed steam is such that part of the steam entering the prime mover must be condensed, any increase in back pressure above normal will have an adverse effect on the overall economy of the station.

A majority of steam distribution piping systems have mains that are large enough to handle a considerable increase in demand without causing excessive drops in pressure. Bottlenecks, however, are often found in the branch lines serving individual processes or departments, especially those most effected by increased production requirements. Where such a condition exists it is necessary to maintain a pressure higher than normal in the whole system in order to deliver an adequate flow of steam through the bottlenecks.

In our plant pressure at the exhaust nozzles of our backpressure turbines had to be held 10 lb above normal in order to cope with increased production requirements. This caused not only a considerable waste of steam through the atmospheric relief valves but also a reduction in much needed electrical generating capacity. A survey made to determine how to reduce the backpressure revealed that the bottleneck existed in one department which had been greatly enlarged a

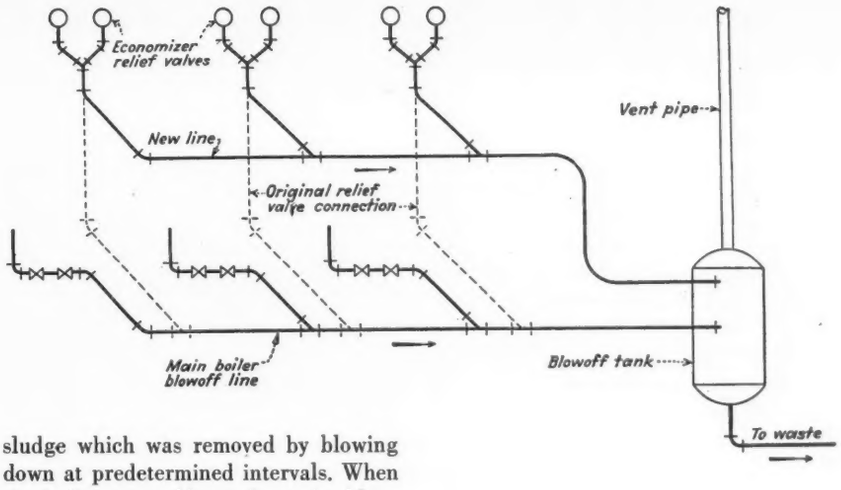
short time before. Substituting a 4-in. for a 2-in. pipe serving this area and making a few other minor piping changes within the department made it possible to reduce turbine backpressure to normal. Exhaust steam loss was eliminated and needed generating capacity again made available.

Richmond, Va. C R ANDERSON

Separate Blowoff Lines Prevent Valves Clogging

AS ORIGINALLY INSTALLED, the escape pipes leading from our economizer water-pressure relief valves were connected to the same piping system serving the boiler mud-drum blowoff valves, as shown by the dotted lines in the figure. Our boiler water contained a high percentage of raw-water makeup and was treated with chemicals injected directly into the boiler drum. This treatment produced large quantities of sludge which was removed by blowing down at predetermined intervals. When the boilers were blown down the blowoff water backwashed into the relief-valve bodies and deposited sludge.

Sludge accumulations in the economizer relief valves gave a great deal of trouble. In some instances the valve bodies were filled up entirely, making it impossible for the valve to lift. To eliminate this difficulty the relief valves were disconnected from the main blowoff line and connected into a separate line leading to the blowoff tank, as shown by solid lines in the drawing. Following this change no further trouble with incrustation of the valve bodies was experienced.



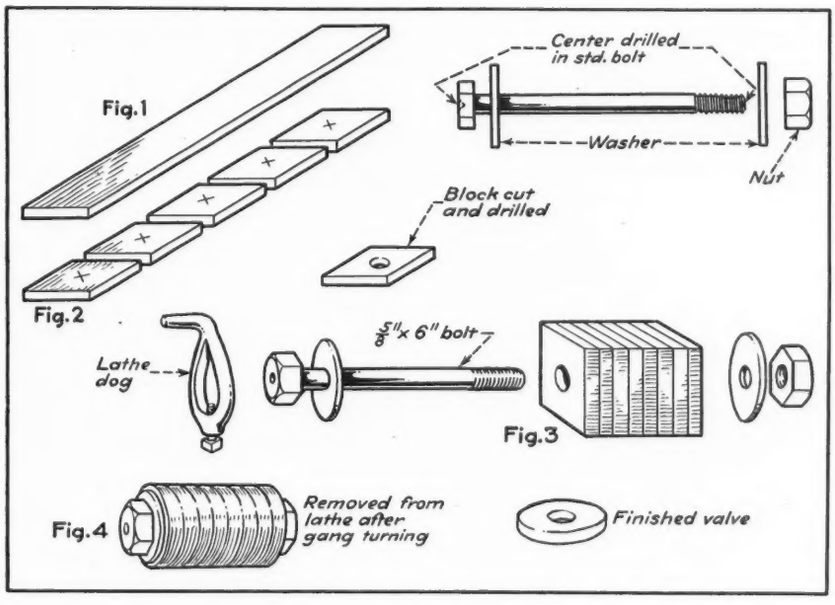
Chicago, Ill. R C HENDERSON

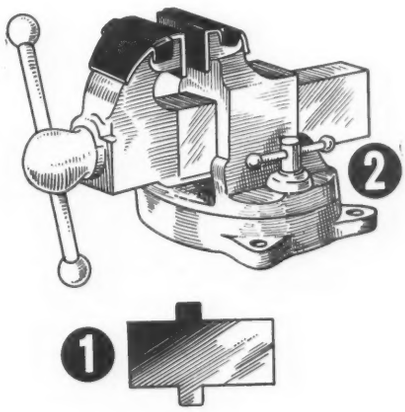
Increased Service From Pump Valves

I HAVE ACCESS TO A MACHINE SHOP and therefore take advantage of it to do many jobs, among them making the valves for our reciprocating pumps. These I make from laminated phenolic material, ½-in. thick which I buy cut in strips the correct width for the valves, Fig. 1. A first step in making the valves is to cut the strips into lengths that form square blocks, Fig. 2. A hole the same size as in the old pump valves is then drilled in the center of each block, after which several of them are assembled on a long machine bolt with end centers drilled, Fig. 3. Then the assembly is put in a lathe and turned to size, Fig. 4.

Material for my pump valves cost about 30 cents per valve, about one-third the cost of an ordinary valve purchased made up, but my home-made valves last several times as long. After about two years' service I resurface them on a sander to remove any ridges that may have formed and they are again ready for service. The valves when new are ½-in. thick and I use them until they are reduced to about ⅜ in. in thickness.

Englewood, N. J. R BOETTINGER





Soft Jaws for Vise Stay In Place

MANY JAWS FOR VISES ARE just pieces of soft metal, copper or lead bent at right angles to fit. Trouble is always experienced to keep these in place. By giving a little thought to their design I make soft jaws that practically lock into place. First, I cut the two pieces of flat metal for the jaws to the shape, Fig. 1. Then they are bent to fit the vise, as in Fig. 2. The only way the soft jaws can get off the vise is to lift them up vertically because they cannot move sideways or toward each other. I have found these jaws a great convenience, especially in operations that require vise to be opened and closed frequently.

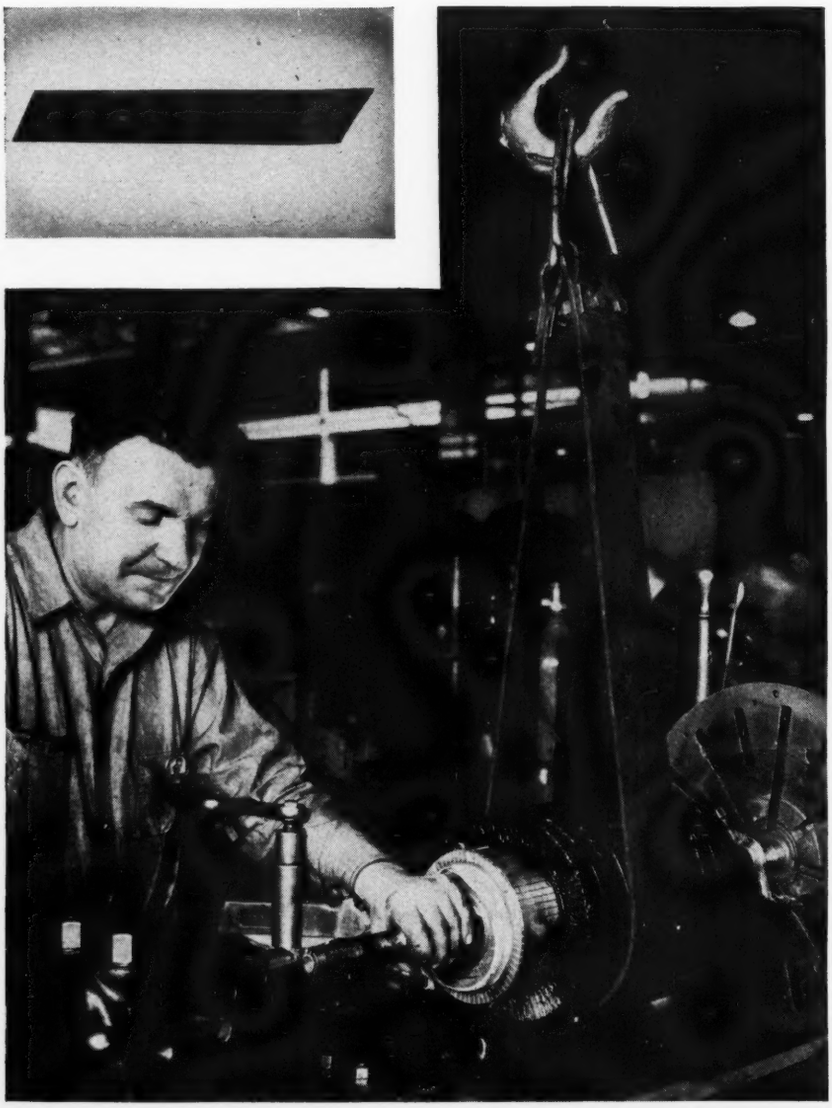
Richmond, Va. C R ANDERSON

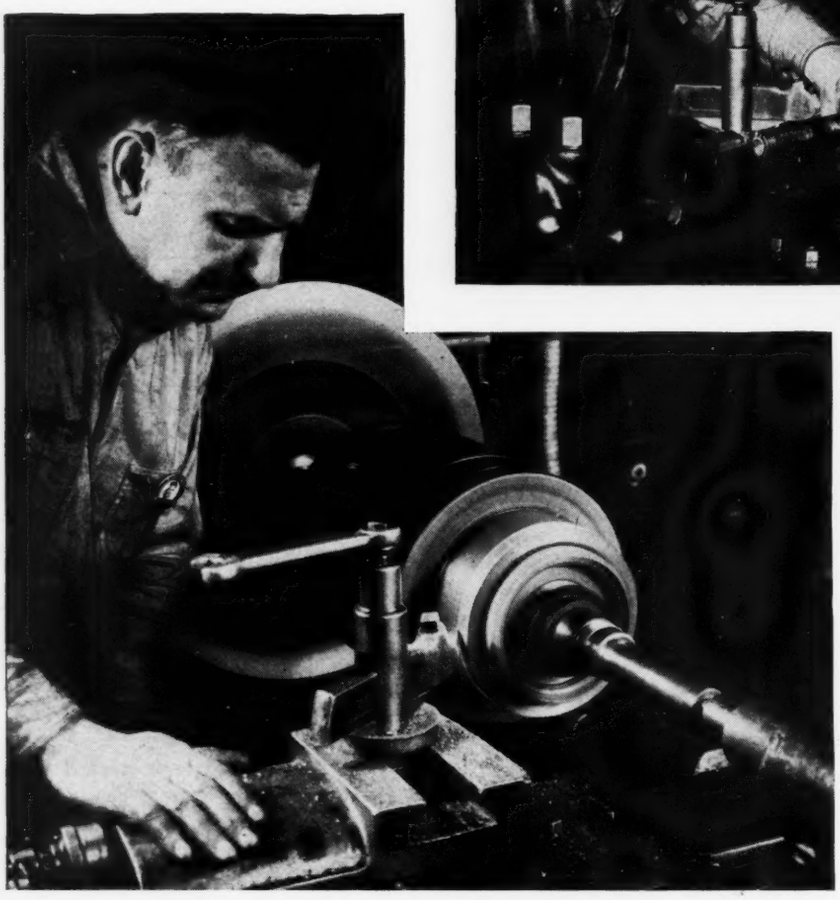
HOW TO RESURFACE

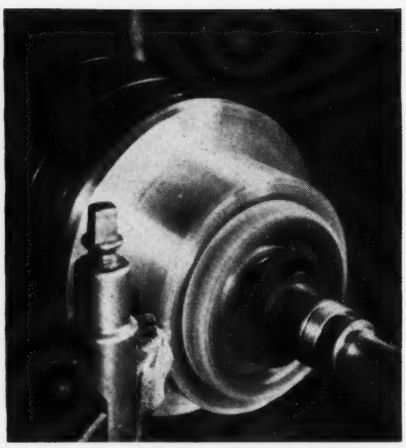
1 Mount armature in lathe with commutator facing tail stock. Preferred and most accurate drive is by face plate and dog on live center. However, if shaft end is held in chuck, check shaft with indicator before starting cut to be sure that commutator will be turned true

2 Commutator should be turned with a flat-top tool, such as this diamond point. A round-nose flat-top tool may be used if the lathe is not equipped with a fine feed to give a smooth surface with a diamond-point tool

3 Adjust lathe speed to give approximately 300 ft per min at commutator surface. To figure the corresponding rpm divide 1200 by the commutator diameter in inches. Thus, right speed for 6-in. diameter commutator is $1200 \div 6 = 200$ rpm. Using finest power feed available, take one or two very light surface cuts across the commutator, removing no more metal than necessary to give a truly concentric commutator



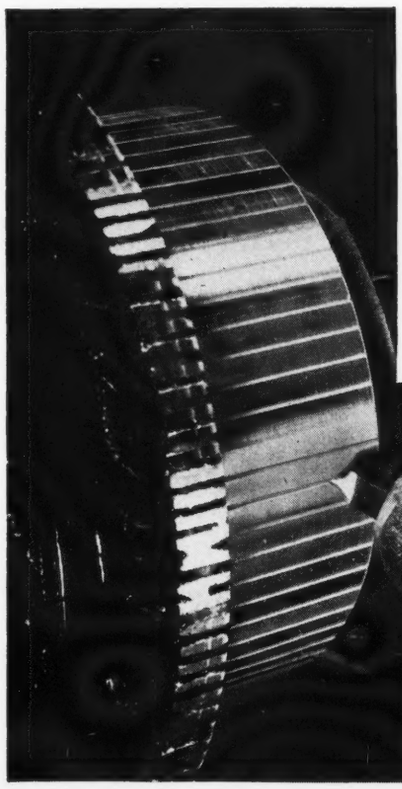


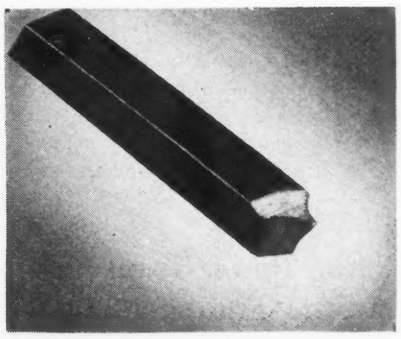


4 Round off sharp edge of commutator with suitable lathe tool or flat file. When filing have armature rotating toward you at moderate speed

A COMMUTATOR

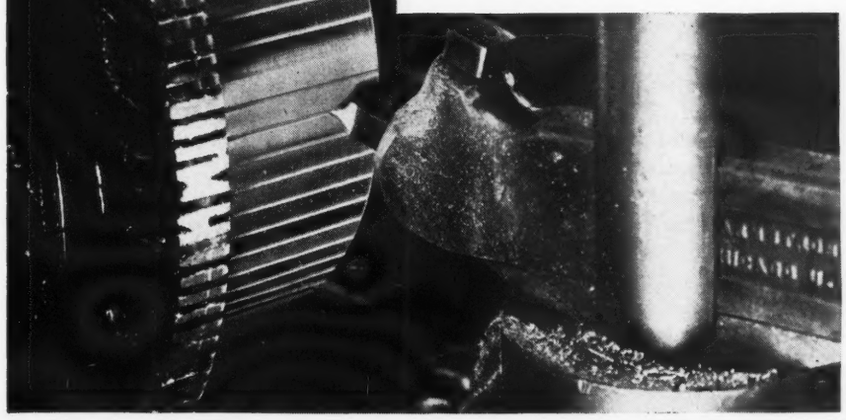
Photographs posed by POWER's photographer in the Newark, N. J., manufacturing and repair dept of Westinghouse Electric & Mfg Co



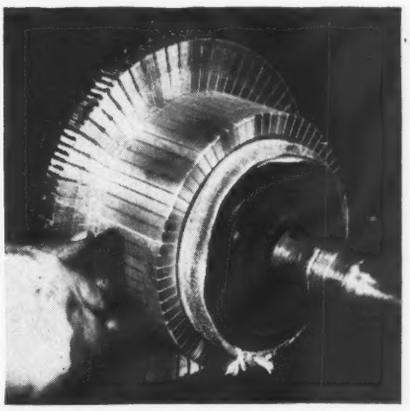


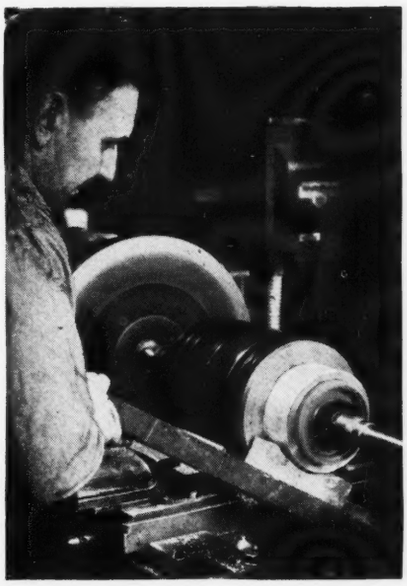
5 If no power cutter is available, mica between bars can be undercut with this specially ground lathe tool. Tool tip has square end and width equal to mica thickness

6 Set this tool sideways in tool holder, facing left. Turn armature by hand until the tool lines exactly with mica. Take several light cuts, cranking carriage from right to left

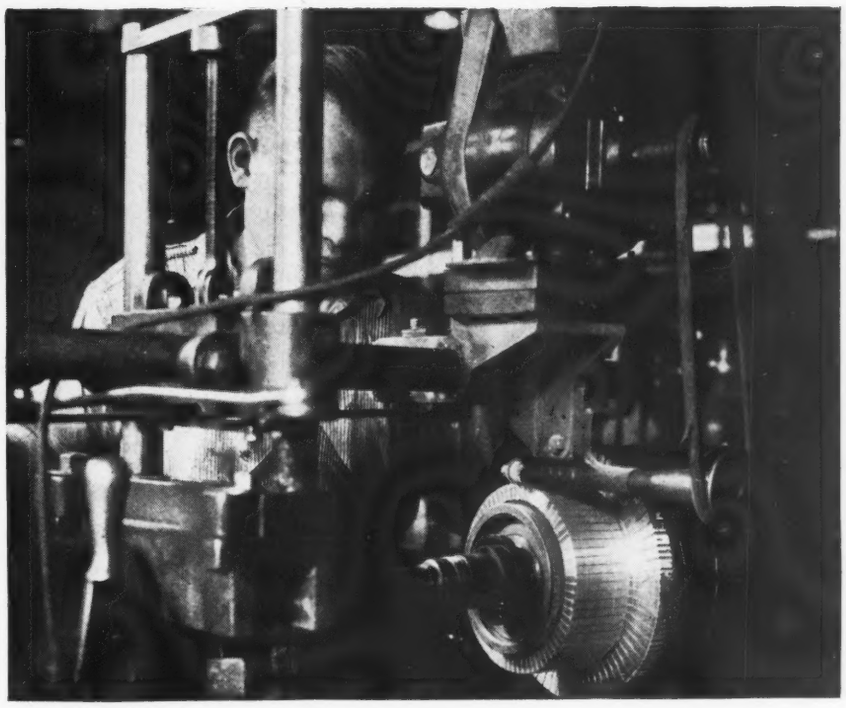


7 To remove burrs, chamfer the edges of each slot with a small chamfering knife or 3-corner file





8 Polish the commutator with stone or sandpaper to remove all tool marks. (Never use emery cloth on commutators). Then remove all foreign matter from slots with thin scraper. Use air to clean armature



9 As an alternative to procedure shown in 6, motor-driven slotting fixtures, such as this, are conveniently available for undercutting mica between bars. In the fixture shown the power unit (motor, belt, spindle and saw) works back and forth on guides parallel to the lathe bed

READERS' PROBLEMS

Questions from Our Readers

Failure of Magnetic Separator

Question 1

WE HAVE A PROBLEM *for which we have as yet found no solution. We recently rewound a magnetic separator pulley which was originally wound with No. 9 round enamel magnet wire for 125-volt dc service. Lack of a spare required restoring this pulley to service. Not having this size wire in stock we substituted No. 10 square double-cotton-covered, varnishing each layer with clear varnish and placing .005-in.-thick untreated paper between layers. After winding, the pulley was baked and filled with compound. It was then returned to service and after two weeks again burned out.*

We stripped this winding and found practically every layer shorted to the adjacent layer, near the end turns, with small pin holes burned in the insulation of the wire itself and through the paper between layers.

We rewound the pulley using No. 10 round single-cotton-covered enamel wire, omitting the paper between layers. It has been returned to service. We are anxious to learn the cause of this failure and a way to prevent its recurrence. The pulley is supplied by a flexible cord and plug connecting to the feed switch.—HDJ

Speedy Removal of Liquid Ammonia

Question 2

WE HAVE 2000 LB OF AMMONIA in our *refrigerating system which serves a large cold-storage establishment. Coastal location exposed to possible bombing attacks together with the fact that numerous employees work in the building basements makes it imperative that we provide for quickly disposing of this liquid ammonia, or neutralizing it in case of a major leak or break in the storage system.*

We have adequate water supply from an outside source as well as a 50,000-gal basement storage tank. What method, if any, could we use to mix this ammonia with water in the storage tank or mix it and then discharge it to waste? In any event it would be necessary to get rid of the ammonia in approximately ten minutes. Can POWER *readers suggest some rapid mixing method permitting safe disposal of our ammonia?*—AST

Rating Power-Transmission Equipment

Answers to Feb Question 1

The Question

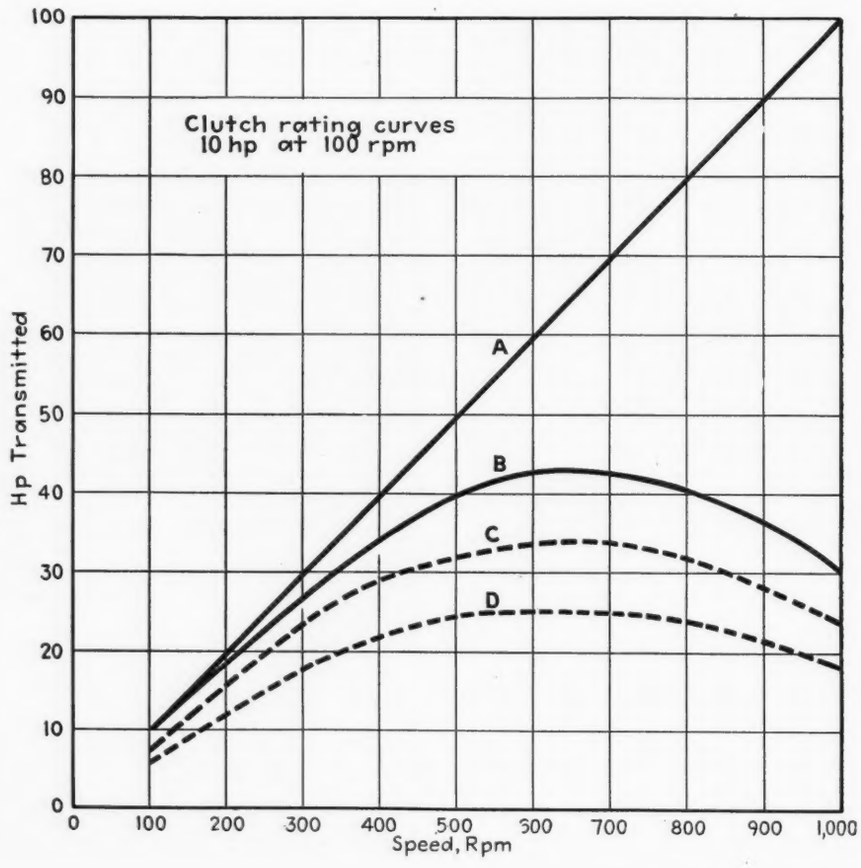
CLUTCHES, SHAFTING, COUPLINGS *and other mechanical power-transmission equipment are rated in horsepower at 100 rpm. I understand that if a clutch is good for 5 hp at 100 rpm, then it is supposed to transmit (300 ÷ 100) × 5 = 15 hp at 300 rpm. This brings up the question of the effect on a clutch of accelerating the 15-hp load to 300 rpm instead of a 5-hp load to 100 rpm. To do the 15-hp job would seem to put a more severe strain on the clutch. Maybe some* POWER *readers can tell me what allowances to make for the higher-speed conditions and how to provide for them. No doubt a discussion of how clutches and couplings are rated would be useful to others.*—MEW

Starting Frequency Affects Clutch Performance

MEW'S SHAFTING AND COUPLINGS can be selected to carry safely any required combination of loads if the working conditions are definitely known. The exact loads may be difficult to determine accurately, especially if machines are started under load. Power-transmission equipment should normally be capable of carrying any load within the rated capacity of the driver.

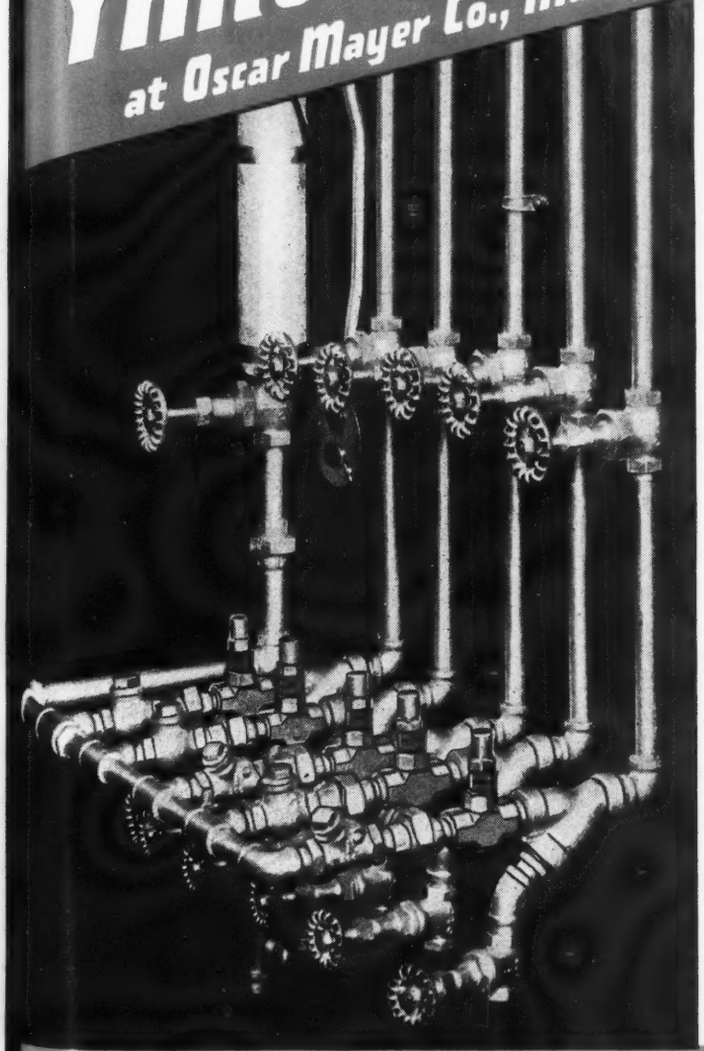
Running load capacity of clutches will be directly proportional to the speed within reasonable limits. The starting capacity for accelerating other than the lightest loads should be less than the running capacity if reasonable maintenance is expected. The reduction in rated running capacity to allow

(*Continued on page* 112)



Smokehouse Coils Heat Quicker, Stay Hot with YARWAY TRAPS

at Oscar Mayer Co., Madison, Wis.



ILLUSTRATED is a five-bank smokehouse at the Oscar Mayer Co. plant, Madison, Wisconsin, showing each bank of tubes individually drained by a Yarway Impulse Trap.

The Yarway Impulse Trap's *continuous discharge on heavy condensate loads* during heating-up periods and its *intermittent operation on light condensate loads* have proven ideal for such smokehouse applications. Further, its *small size permits compact, efficient piping* arrangements that *save space, installation time and money.*

Have you investigated this steam trap that has solved many modern trap problems in the Food Processing Industry—that *saves time starting up* and *keeps equipment at top performance,* that *saves fuel, reduces maintenance* troubles and often *costs less to buy than to repair other traps?*

More than 130,000 Yarway Traps are already in service and sales are at an all-time high.

Ask your Mill Supply Dealer or write for Bulletin T-1736.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia, Pa.

YARWAY IMPULSE STEAM TRAP

for load acceleration will depend on the number of times per hour the load is started, the value of starting load in relation to load at rated speed, the type of clutch and provision for cooling, and the importance of the drive to plant operation.

The graph on page 110 illustrates the reduction in clutch rating for several conditions of operation. Curve *A* shows the power a clutch of 10-hp rating at 100 rpm will transmit at other speeds, ignoring load acceleration. This applies if starting loads are definitely known to be low in relation to running loads. Curve *B* shows the rating for the same clutch based on full-load starting once per hour. Curves *C* and *D* are based on the same loads as *B* with 10 and 20 starts per hour respectively.

Above 400 rpm special balancing of clutch parts is required. Maximum clutch speed depends on clutch size and materials. If power to be transmitted cannot be estimated, a clutch should be selected to carry full shaft capacity. If full loads must be accelerated more than 20 times per hour, special designs are required.

St. John, N.B. C G Clark

Applied Force Stays The Same

The horsepower of a shaft, coupling or a clutch is expressed in the following terms:

$$H_p = \frac{2\pi \times \text{torque} \times \text{rpm}}{33{,}000}$$

If the rpm is increased the hp goes up proportionally. It can be seen, then, that the torque remains the same at 100 rpm or at 300 rpm. The force applied is the same in both cases as torque is equal to force times the radius.

Flushing, N. Y. Frank Raphaelian

Driven Load Important

The horsepower to be transmitted through a clutch or coupling is only an approximate gage of the size to be used. Nature of the load, starting characteristics, and type of driving medium should also be considered. Pulsations characterize reciprocating-engine and compressor-drives; centrifugal pumps and motor-generator sets are examples of steady, easy-starting loads.

All manufacturers use a service factor by which the horsepower of the load is multiplied. For example, if the coupling is to be used to transmit 50-hp from a steam engine to a crusher, the service factor would be 2½, requiring a 125-hp coupling. For clutches, add one percent for each engagement per hour. These are factors used by one company.

The formula MEW uses is approximately correct, though practically all manufacturers give a more conservative rating. One manufacturer rates a flexible-chain coupling at 4.73 hp at 100 rpm, and 12.82 hp at 300 rpm. One friction clutch is rated at 6 hp for 100 rpm, and at 12 hp for 300 rpm.

If work must be done before the driven shaft has reached full speed after clutch engagement, the capacity must be based upon this speed instead of full speed. When it is desired to relieve machinery and shafting of shock loads by slipping, friction cutoff clutches are installed.

For specific cases and unusual conditions I would recommend that MEW consult the manufacturer's engineering department.

Milwaukee, Wis. L M Larson

Clutch Troubles

When discussing horsepower, the time element is an important factor to be considered. One hp = 33,000 ft lb per min. Thus the standard is set for friction clutches as for other equipment rated in terms of horsepower.

To seek to increase the horsepower of a clutch by increasing the speed, we are demanding more than the clutch is rated and designed for. In the same manner, when we operate boilers at several times rating we looked for extra wear and tear on these units in the form of blistered tubes, leaking seams, brickwork failure, etc.

Extra demand on a clutch results in slipping, burning of plates, or broken and twisted shafts if overloaded too severely. From experience with multiple-plate clutches, I have found that failure to perform their duties in some cases was caused by improperly machined faces. After being dismantled and the plates scraped to a true face-to-face bearing, these gave 100% service.

Another case of failure was found to be caused by the operating gear, which allowed the toggle-spring adjustment too much travel past the center, thus permitting the spring pressure on the clutch to be partially released when the clutch was at "full in" position.

Attempting to remedy a slipping clutch by introducing talcum powder or a "fierce" clutch by applying kerosene, is an undesirable practice and will soon lead to trouble.

Kearny, N. J. Geo McNally

Boiler-Feed Pump

Answers to Feb Question 2

The Question

In our plant we should have *a reserve boiler-feed pump. We have a spare pump which is suitable for this purpose in every way except that we have no driving unit. As the pump is complete with necessary bearings we would like to use a belt drive from our main engine shaft. Using this drive requires only a short run of piping and will permit us to utilize available power from the engine. By driving the pump in this manner we will have no control of the speed, and as the boilerwater level is controlled automatically, what governing devices can or must we use to prevent damage to the pump? Will this setup make a dependable supply and allow keeping one governor-controlled pump as a standby unit?*—RKT

Protect Against Speed Variation, Suction Loss

It is unfortunate that the information contained in RKT's question is so meager, as the problem is an extremely interesting one. We shall assume that the pump in question is an exact duplicate of the two pumps now supplying feedwater to the boiler.

The engine itself probably runs at such a speed that the problem of belting the pump to the engine is not an insurmountable one. While it might be best to use a V-belt drive, a flat belt is satisfactory and perhaps more easily obtained. If possible, it would be best to avoid using an overhung pulley, and to mount the latter on a jackshaft between pedestal bearings.

The choice of the respective pulley sizes is important, as it involves the final operating pump speed. The engine speed is not constant, nor can it become dependent in any way upon the boiler-feed pump requirements. Some variation in engine speed will occur in operation and, therefore, it is imperative to design the belting ratio so that even with the engine speed below normal, the centrifugal pump will generate sufficient pressure to feed the boiler and, if necessary, to operate in parallel with other units.

To insure proper parallel operation between the belted pump and the other units, the minimum speed of the belted pump must be suitable to produce re-

(*Continued on page* 114)

"BUBBLE, BUBBLE!"

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(Continued from page 112)

quired pressure. However, should this pump be permitted to operate uncontrolled, the slightest increase in engine speed over its minimum would cause the belted pump to generate a pressure sufficient to slam the check valves on the other units.

To avoid this, it will be necessary to install a spring-loaded diaphragm-controlled pressure governor in the discharge of the belted pump, immediately beyond the gate and the check valve. One side of the diaphragm will be connected through a pilot line to the downstream side of the valve and the other to the upstream side of the check valves on the existing two pumps. A small valve should be located in each of the split pilot lines, so that the diaphragm-controlled pressure regulator would be operative regardless of which pump is running. If the belt-driven pump is used alone, the control can be disconnected. Any excess pressure generarted through overspeeding of the pump will cause the valve to close down and throttle off this excess pressure.

There are, however, a number of precautions to take. The first is to check the suction conditions thoroughly. The difference in location may increase the friction losses in the suction piping to such an extent that the net positive suction head is decreased beyond its permissible minimum. The size of the suction piping must, therefore, be selected to avoid this possibility.

A bypass line must be installed in the new pump discharge line, leading from the pump side of the check valve back to the suction source. This bypass will protect the pump against overheating resulting from any unintentional, but possible, operation at shutoff. If such bypass lines are not present in the discharge of the existing feed pumps, they should be installed immediately.

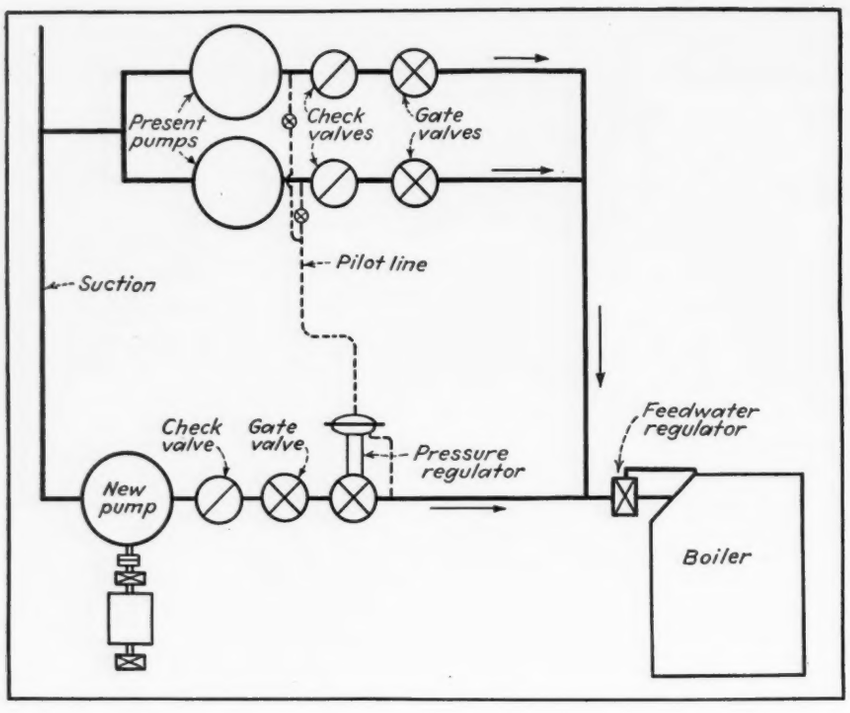
With consideration for all the precautions listed, the setup will make a dependable feedwater supply.

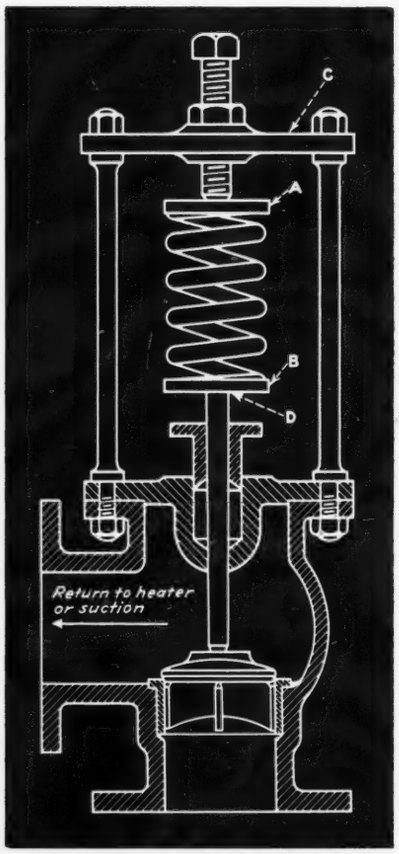
South Orange, N. J I J KARASSIK

How to Build Relief Valve

THIS QUESTION DOES NOT STATE whether the pump is reciprocating or centrifugal; however, centrifugal pumps having constant-speed-motor drive are widely used today as boiler-feed units. In RKT's case, the pump will be a constant-speed unit when driven from the main engine shaft, so that the most sensible solution will be to fit a relief valve on the discharge line.

In these days of priorities it may be difficult to purchase a valve for this particular case, so I submit the accompanying sketch as a guide that may solve the problem. Any valve of suitable strength may be adapted by adding the two upright stays as shown. The bridge *C* may be made from a piece of boiler plate or suitable channel iron.





The plates *A* and *B* can also be made from the same material and welded, brazed or counterbored at *D*. This should serve the purpose with safety and satisfaction in the emergency.

Kearny, N. J. GEO MCNALLY

Install Relief Valve Between Pump, Heater

RKT CAN PROTECT HIS PUMP against shut-off pressures with a relief valve in the discharge line. This valve should be connected to the discharge line between the pump and feedwater regulator. The relief-valve discharge should be piped back to the makeup tank below the normal water level. If a closed heater is installed between the pump and boiler the relief valve should be installed between the pump and heater. This will eliminate steam binding of the pump caused by overheating the water in the makeup tank.

Lowell, Mass. JOHN HETHERMAN

Bypass is Inefficient

RKT CAN USE HIS CONSTANT-SPEED PUMP economically for boiler-feed service by installing a spring-loaded relief valve in the discharge line immediately after the pump to discharge to the hotwell. If the relief valve adjustment is set to

(*Continued on page* 116)

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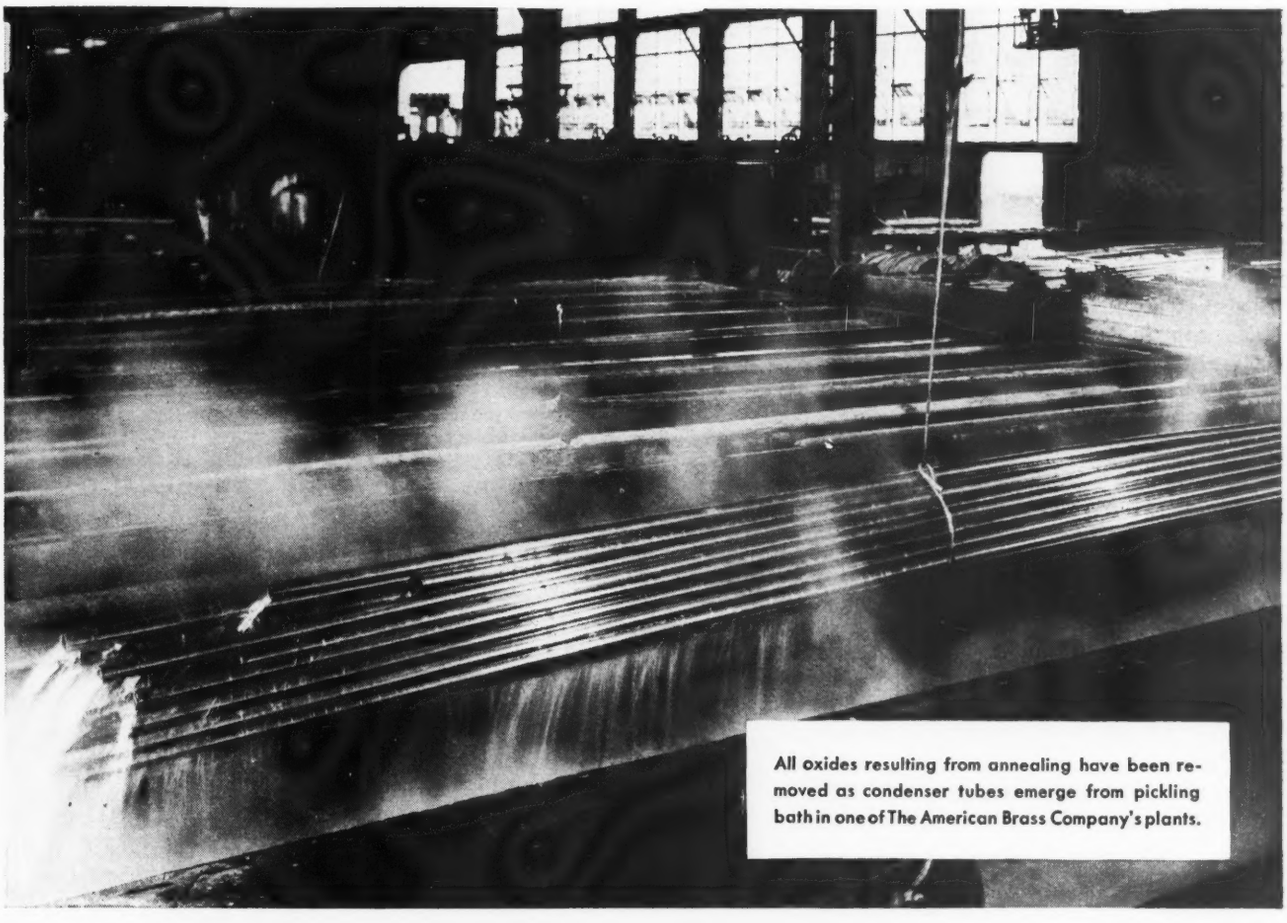

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open at 5 psi above the normal feedline pressure, it will automatically bypass the discharge when the boiler water level is normal.

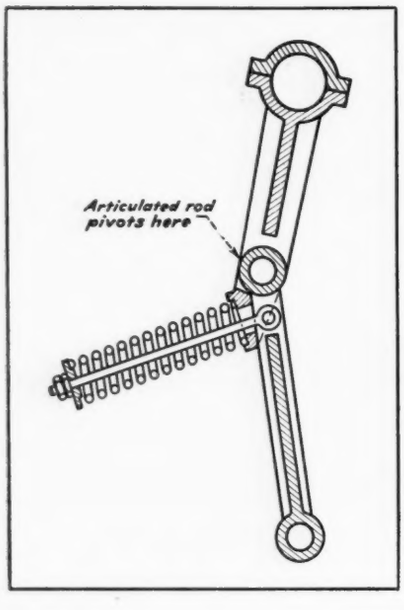
This system of discharge control of a constant-speed pump is 100% foolproof. The only objection to using it as a base-load feed-pump control is that the pump will always deliver against a high head, thereby placing a greater demand on the engine shaft; a speed governed pump, however, has a horsepower demand proportional to the water delivered to the boiler.

Wellsville, N. Y. E C CURRY

If You Like To Work Here's the Answer

IN RKT'S QUESTION the pump might be either a centrifugal or a positive-displacement unit, so the writer chooses to assume it is a relatively old, slow-speed single-acting vertical triplex pump. We also assume that this is a reciprocating engine, operating at a moderate speed, since such an engine is more likely to have a shaft easily accessible for a belt drive. The engine has a speed variation of 5 to 10%, acting contrary to the requirements of boiler feeding, making the problem more difficult.

RKT can use a variable-speed drive, if one with a suitable range and capacity can be obtained. Such a unit could be made to maintain a constant discharge pressure automatically. A constant-torque hydraulic or electrical slip coupling might be used, but is expensive and would be no more efficient than regulation of the discharge through a simple bypass control.



The problem is to obtain variable discharge over a wide range at approximately constant pressure. With a single-acting pump this can be achieved in the following manner: Replace the solid connecting rods with articulated connecting rods, arranged to transmit only a predetermined maximum force, as shown in the accompanying illustration. This rod is hinged on a pin displaced from the centerline of the rod and normally is held rigid by the spring as shown. At a predetermined load the rod collapses, returning to the unloaded position before the start of the next stroke. The loading, or discharge pressure at which this occurs may be adjusted by varying the compression of the spring or the displacement of the hinge pin. No power is consumed since energy absorbed by the spring on the down stroke is returned, less any friction losses, on the next suction stroke.

Thus a positive-displacement pump may be provided with an automatic relief without appreciable power losses. This would prevent damage to the pump and eliminate the need for any additional governing devices except those possibly required for satisfactory parallel operation with existing equipment. Of course, it might be just as economical, and probably more dependable, to find an old variable-speed dc motor suitable for driving the pump directly.

Harrison, N. J. E F WRIGHT

Consider Overhung Weight of Pulley

THE QUESTION BY RKT can be attacked from many angles, as a number of assumptions must be made. The problem resolves itself not only into protecting the pumps but also one of adequately protecting the boiler. It appears that the pump which RKT now has on the line is equipped with a feedwater regulator which automatically controls the boiler-water level.

Since no mention is made of the turbine operating speed, we assume that the turbine is operating at 3600 rpm. The pump on hand has suitable bearings for belt drive, but it has been my experience that centrifugal pumps on the market today are usually designed for direct drive and the bearings are usually not suitable for carrying the overhung weight of a pulley and the pull of a belt. When a pump is specified for service such as outlined, it requires a larger shaft to make it safe against critical speeds because of the pulley. This can be checked by consulting the manufacturer. I would suggest the use of pedestal bearings with the pulley mounted in the middle of the bearing supports. Since the required horsepower is not stated, it is quite difficult to ascertain whether or not a belt drive is suitable. We do not, however, operate any belted unit at 3600 rpm that carries more than six V-belts transmitting about 15 horsepower. Belt speed should be kept below 5000 fpm.

Knowing the maximum permissible speed to produce necessary working pump pressure, we are able, after determining brake horsepower required, to find the speed of the pump. Turbine speed is usually limited to a small variation and we can select a pump speed so that the pressure developed will not exceed safe working limits. When figuring the maximum working pressure of the pump, it will be necessary to plot the performance of the pump at its maximum speed. The pressure on the performance curve must at no point exceed the working pressure of the pump.

The next problem becomes one of safeguarding the pump against possible operation at shutoff. The best way to do this is to install a reducing orifice which will permit bypassing a minimum quantity of water to prevent overheating. In this case we would suggest that an automatic orifice control be operated by a flow meter in the suction line of the pump. As soon as the flow decreases to a certain minimum point, the bypass orifice would open and recirculation would begin. The bypass orifice should be installed ahead of the check valve so that the pump will be able to recirculate the water. Lack of adequate bypass at low flows is a common cause of pump seizure.

East Orange, N. J. R C MCDONALD

Thanks, anyway

We wish to acknowledge answers submitted by the following readers for which space was not available: A R Eastcott, Brentwood Bay, B. C.; H D Brown, Lombard, Ill.; Anthony Greer, Bronx, N. Y.; W T Mullen, Philadelphia, Pa.; Harry Parkinson, Galt, Ontario; L M Larson, Milwaukee, Wis.; F C Williams, Cedar Rapids, Iowa; Frank Ralphaelson, Flushing, N. Y.; F E Bateman, Libby, Mont.; C G Clark, St. John, N. B., A R Ciotti; Cleveland, Ohio; and E A Roberts, Roswell, N. J.

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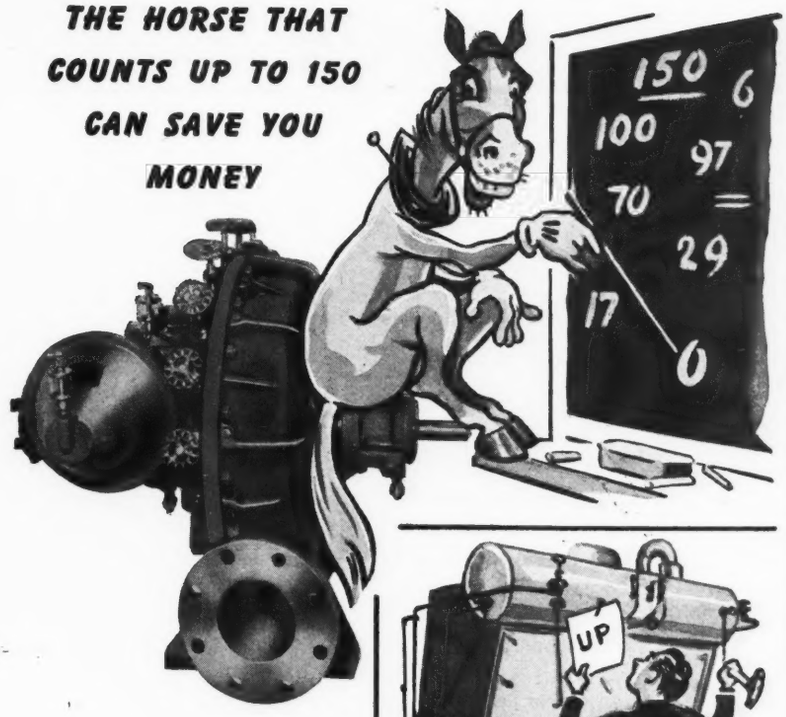

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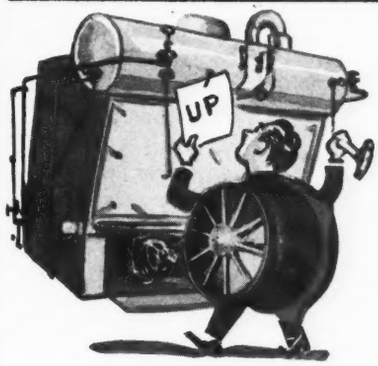

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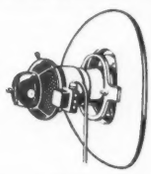

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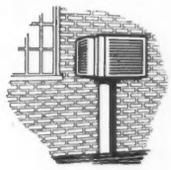
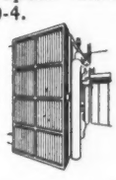


☐ Coppus Air Filters. For engines and air compressors. Perfect, uninterrupted filtration. Bulletin F-310-4.



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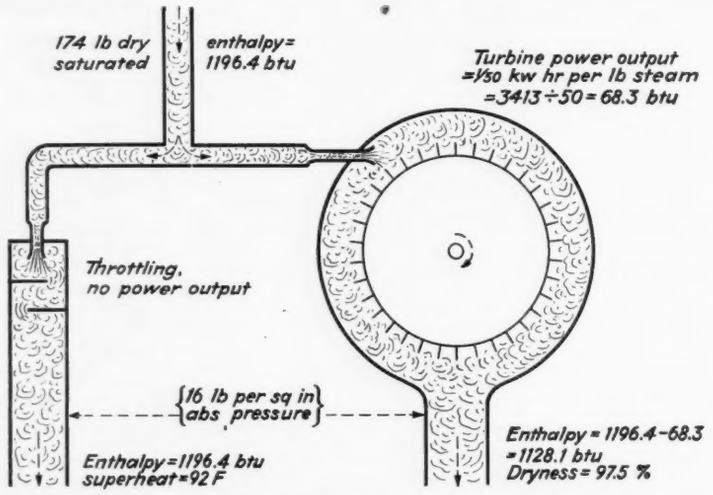
Expanding Steam

BY PHIL SWAIN

If you keep a given weight of wet steam at constant pressure and gradually apply heat, the steam will get dryer and dryer until it becomes dry saturated. It will then start superheating, with a steady rise in temperature. Any movement in this direction (from wet steam to dryer steam, or from a lower superheat to a higher) may be called an *improvement* in steam quality. Conversely any movement in the opposite direction may be called a *lowering* of steam quality.


174 lb dry saturated
enthalpy = 1196.4 btu
Turbine power output = 1/50 kw hr per lb steam = 3413 ÷ 50 = 68.3 btu
Throttling, no power output
16 lb per sq in abs pressure
Enthalpy = 1196.4 btu superheat = 92 F
Enthalpy = 1196.4 - 68.3 = 1128.1 btu Dryness = 97.5 %

Throttling usually raises steam quality, whereas expansion through a turbine usually reduces quality, and more so as the turbine efficiency is higher

When steam is throttled, its quality is always improved.[1] If it was dry saturated it becomes superheated. If it was superheated it becomes more highly superheated. If it was wet it becomes dryer, and perhaps superheated as well. These statements refer to true throttling, which is the reduction of pressure without performance of useful work.

Turbine vs Reducing Valve

It is often said that an engine or turbine exhausting to process acts as a reducing valve. This is not strictly correct; the turbine extracts useful power from the steam, so that the enthalpy of its exhaust steam is less than the enthalpy of steam lowered to the same pressure by a reducing valve.

The diagram shows this clearly for the expansion of steam from dry saturated condition at 174 psi absolute pressure to a backpressure of 16 psi abs. Initial enthalpy equals 1196.4 Btu.

For straight throttling the rule is that enthalpy after is same as before expansion. Thus the steam's final enthalpy must be 1196.4 Btu. The enthalpy of *dry saturated steam* at 16 psi abs is 1152.0 Btu so the steam must be superheated the equivalent of the difference, or 44.4 Btu. Roughly, one Btu will superheat steam about 2 F, so the superheat after throttling will be approximately 89 F.

Table 1 gives data for 16 psi absolute pressure. From this, exact superheat of throttled steam can be figured as follows:

	Enthalpy	Steam Temp
	1202.0	320
less	1192.5	300
Difference	9.5	20

This is the first step in what is called *interpolation*, the process used to find at what temperature between 300 and 320 F the enthalpy is 1196.4 Btu. Next perform the following subtraction:

	1196.4
less	1192.5
Difference	3.9 Btu

It is clear that the temperature will exceed 300 F by 3.9/9.5 of 20 F. This is 8 F, so the final steam temperature will be 308 F. Since saturation temperature at 16 psi abs is 216 F, the superheat is 308 − 216 = 92 degrees.

Condition of Turbine Exhaust

Next consider expansion of the same steam through the turbine. Since one kwhr equals 3413 Btu, and since the turbine produces 1/50 kwhr from each pound of steam, the reduction in enthalpy per lb will be 3413 ÷ 50 = 68.3 Btu. This assumption neglects generator losses and heat radiated from the turbine shell, but is not far wrong.

The enthalpy of the exhaust steam will be about 1196.4−68.3=1128.1 Btu. Dry saturated steam at 16 psi abs contains 1152.0 Btu, so the turbine exhaust steam must be wet. Enthalpy of evaporation at 16 psi abs is 967.6 Btu, or 9.68 Btu for each one percent of moisture. Since 1152.0 − 1128.1 = 23.9 Btu, moisture in exhaust steam will be 23.9 ÷ 9.68 = 2.5%. Therefore turbine exhaust steam will be 97.5% dry, whereas steam discharged from the reducing valve was superheated 92 F.

Table 1

Enthalpy at 16 psi abs

(From Table 3, Keenan & Keyes)

Saturated water	184.4 Btu
Evaporation	967.6 Btu
Dry sat. steam	1152.0 Btu
Steam superheated to 300 F.	1192.5 Btu
Steam superheated to 320 F.	1202.0 Btu

All references to steam tables in this series are to the "Thermodynamic Properties of Steam" (1936 Edition), by Keenan and Keyes, published by John Wiley & Sons, Inc, New York. Sections reproduced by permission of the publishers.

[1] Exceptions to this rule may be found where initial pressure is higher than 500 lb. We are here concerned with lower initial pressures.

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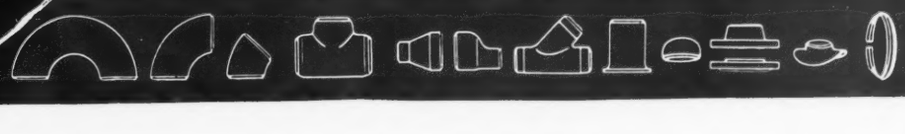


POWER LINES

OBITUARIES

HORACE L MANN, president of the Buffalo Niagara Electric Corp, died Feb. 10 at his home in Buffalo. He was 69 years of age. One of the pioneers in the development of the electric utility business in this section of the country, Mr Mann was connected with Buffalo Niagara Electric Corp and its predecessor company for the past 33 years, having joined the Buffalo General Electric Co in 1909 as treasurer. In 1926, when Buffalo Niagara and Eastern Power Corp was organized, Mr Mann was made vice-president and treasurer, and a year later became a director. He was also vice-president and director of several western New York operating companies of the Niagara Hudson Power System, and was a director of Niagara Hudson Power Corp.

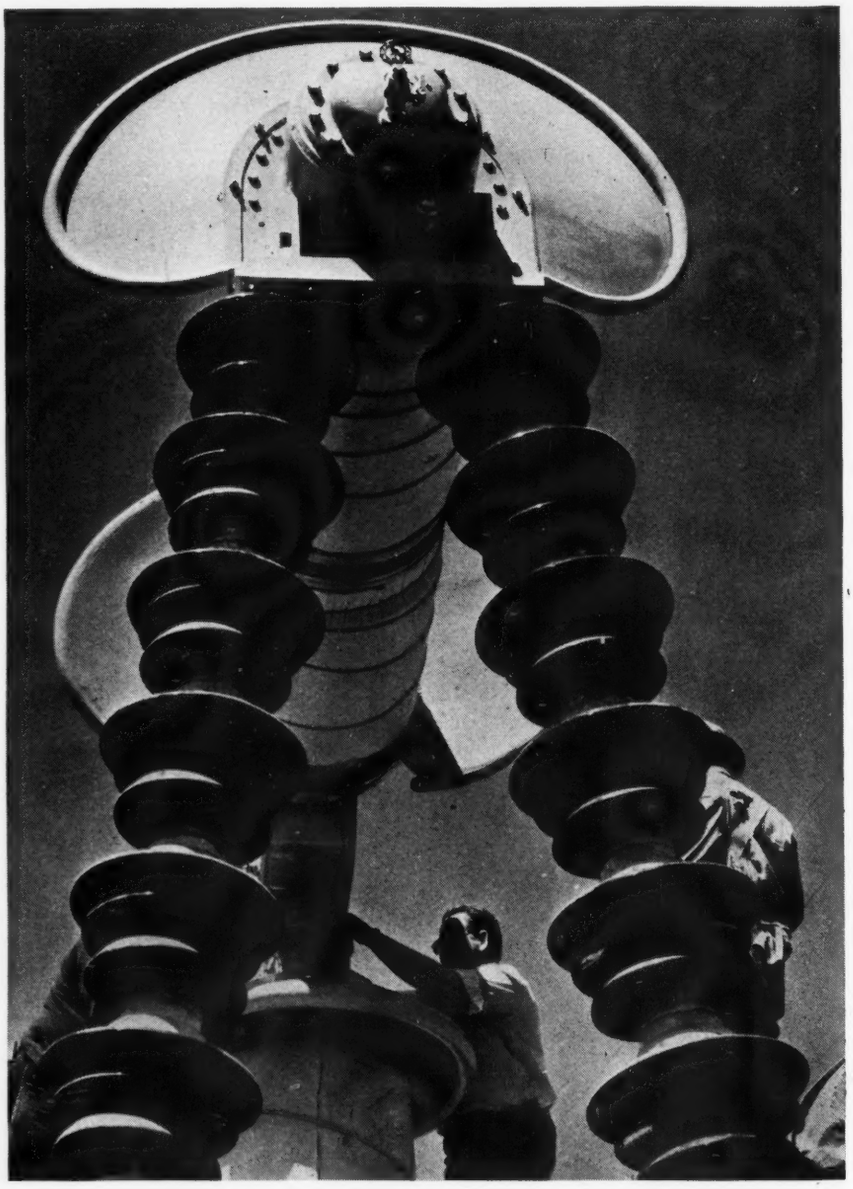
W W WILLIAMS, California representative of Babcock & Wilcox Co, and Pittsburgh Crucible Division, Crucible Steel Co of America, died Feb. 10 in Los Angeles, Calif. Mr Williams was well known throughout eastern steel circles, having formerly been general manager of B&W, and also associated with Reading Iron Co, the Bourne Fuller Co, and Pittsburgh Gauge & Supply Co.

JAMES HAY, watch engineer at No. 1 generating station of the Lawrence Gas & Electric Co, Mass., died recently. He was born in Scotland and came to America at 21. After working at the old Parker House in Boston as fireman, and at the Braintree, Mass., electric light plant as engineer, he went to Lawrence in 1900 as an engineer in the Pemberton Mills. He joined the Lawrence utility in 1910.

PERCY NICHOLLS, supervising engineer of the Fuels Section, U. S. Bureau of Mines, and life member of the American Society of Heating and Ventilating Engineers, died on Feb 12. He was in his 72nd year. Mr Nicholls was born in London, England, in 1870, and graduated as master of science in engineering from Leeds University. He came to the United States in 1897 as an engineer with the Westinghouse Electric & Mfg Co, for whom he spent 1899 and 1900 in France. In 1915 he became interested in heat transmission and solid fuel combustion. He joined the laboratories of the American Society of Heating and Ventilating Engineers in 1922 and was appointed engineer of the Fuels Section of the U. S. Bureau of Mines in 1925. Mr Nicholls was the author of many technical papers on combustion and solid fuels. In addition to his association with the ASHVE, Mr Nicholls was a member of the American Society of Mechanical Engineers and a charter member of the Physical Society of Pittsburgh.

REGINALD P BOLTON, engineer and student of colonial and Revolutionary history, died Feb. 18 at his home in New York City. Mr Bolton was president and chairman of the board of the Electric Meter Corp, New York City, and president of R P Bolton Co. As a consulting engineer, Mr. Bolton designed and erected machinery for mines, shipyards, marine engines and power plants in all parts of the world. Since 1893 Mr Bolton had been actively engaged as a consulting engineer in New York City, serving with the Department of Water Supply of New York. Among the engineering projects for which he had been responsible are the plant system of R H Macy & Co, and the Grand Central Terminal. Mr Bolton was born in London, England, and was educated in

(*Continued on page* 122)



Closeup of one of the sets of insulators from the fastest operating oil circuit breaker in this country. Built by General Electric, the breaker will interrupt 2,500,000 kva at 230,000 volts in three cycles (about 1/20 sec) if a fault occurs in the transmission system. The breaker protects power lines from the Bonneville project

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ALTER EGO: Literally, "one's other self"—the still, small voice that questions, inspires and corrects our conscious action.

private schools. He served his apprenticeship with Powis, James & Co, Lambeth, England, and gained his early drafting experience in Colchester and London with Davey Paxman Co. Mr Bolton came to America in 1879 and engaged in consulting practice. Until 1892 he spent much of his time traveling in Europe on engineering work. Mr Bolton was elected a member of the American Society of Heating and Ventilating Engineers in 1897, and since that time served in many official capacities in the Society.

HAYS H CLEMENS, president of the Board of Directors of the Erie City Iron Works, Erie, Pa., died Jan 27, 1942.

CHARLES CLARAGE, 81, president of the Clarage Fan Co, died Feb 6. Shortly after leaving school Mr Clarage joined his father in a foundry and machine business. When the elder Clarage died in 1895, the business went to Charles and his two brothers. The brothers withdrew, however, and Charles carried on. Early in the present century the foundry developed a stoker manufacturing business, and in 1912 started building fans and blowers. In 1915 the concern became known as the Clarage Fan Co, with Charles Clarage as president. Mr Clarage held this office until the time of his death.

THOMAS BARROWS, 65, power plant engineer at the River Works of the General Electric Co in Lynn, Mass., died recently of a heart attack. He had been employed by the company for several years.

PERSONALS

JAMES S ANDERSON is now connected with the New York district sales office of the Babcock & Wilcox Tube Co, 85 Liberty St, New York, N. Y. Mr Anderson comes to B & W from the Steel & Tubes Division of Republic Steel Corp, where he was affiliated with their Cleveland general sales office, and the Philadelphia district sales office. He is a graduate of the Case School of Applied Science.

JAMES F MCNAMARA, of New York, mill products sales manager of the International Nickel Co, was elected a member of the board of directors of Lukens Steel Co at the company's annual meeting of stockholders. Mr McNamara joined the International Nickel Co as a salesman 31 years ago, later becoming vice president and general manager of the Monel Metal Products Corp. In 1921 Mr McNamara was made sales manager of all mill products of the company, in direct charge of finding and expanding new markets and establishing and developing the company's sales agencies.

GEORGE H WOODARD has been appointed manager of the new products division of the Westinghouse Electric & Mfg Co. Mr. Woodard joined the company when the new products division was created in 1936 for the development of products which have not yet reached the state of commercial apparatus. After filling the position of new products engineer at the Westinghouse South Philadelphia works for two years, he was brought to the division's headquarters at East Pittsburgh, in 1938. Besides directing development of new products, Mr Woodard will continue as executive assistant in the company's emergency products division, responsible for the negotiation of government contracts for ordnance material.

WALTER GEIST, vice president of Allis-Chalmers Mfg Co, is to head a new department, established to coordinate the company's sales policies. The duties of this department will be not only to formulate and put into effect sales policies, but also to correlate and unify the selling activities for all the company's products, with the exception of those of the tractor department.

GEORGE F NUERNBERGER has been named safety engineer of the Allis-Chalmers Mfg Co. In 1939 Mr Nuernberger entered the Allis-Chalmers Co as a graduate engineer in training, completing his course in Nov, 1941. He was appointed safety engineer after serving as the industrial relations department research engineer. In his new capacity, Mr Nuernberger will supervise and direct the company's extensive safety program.

DETROIT REX PRODUCTS CO, Detroit, Mich., announces the promotion of W F NEWBURY to central regional manager.

GEORGE A FOWLES has been appointed a sales engineer in the synthetic sales division of the B F Goodrich Co, with cable and wire insulation problems as his special field. Mr Fowles was graduated from Massachusetts Institute of Technology as a bachelor of science in electrical engineering. He developed various rubber insulating compounds for special types of cables and obtained a patent on the vulcanization of rubber insulated wire by high frequency radio waves. He is an associate member of the American Institute of Electrical Engineers.

S E SCHULTZ, chief engineer of the Bonneville Power Administration, has joined the staff of J A Krug, chief of the War Production Board Power Branch, as a power supply consultant, particularly on Northwest power problems.

RALPH R NEWQUIST has been named assistant to Walter Geist, vice-president of the Allis-Chalmers Mfg Co. Before assuming his new position Mr Newquist was the manager of the Allis-Chalmers district office at Houston, Texas. He has also served in the firm's district offices in Chicago, Pittsburgh and Boston. He joined the company in 1934.

DONALD T MCDONALD has been appointed manager of sales promotion and publicity, a newly created department of the Crocker-Wheeler Electric Mfg Co. Before joining the Crocker-Wheeler organization in 1941, Mr McDonald was with the Westinghouse Electric & Mfg Co as advertising section head at East Pittsburgh. Mr McDonald is making his headquarters in the New York offices of the company.

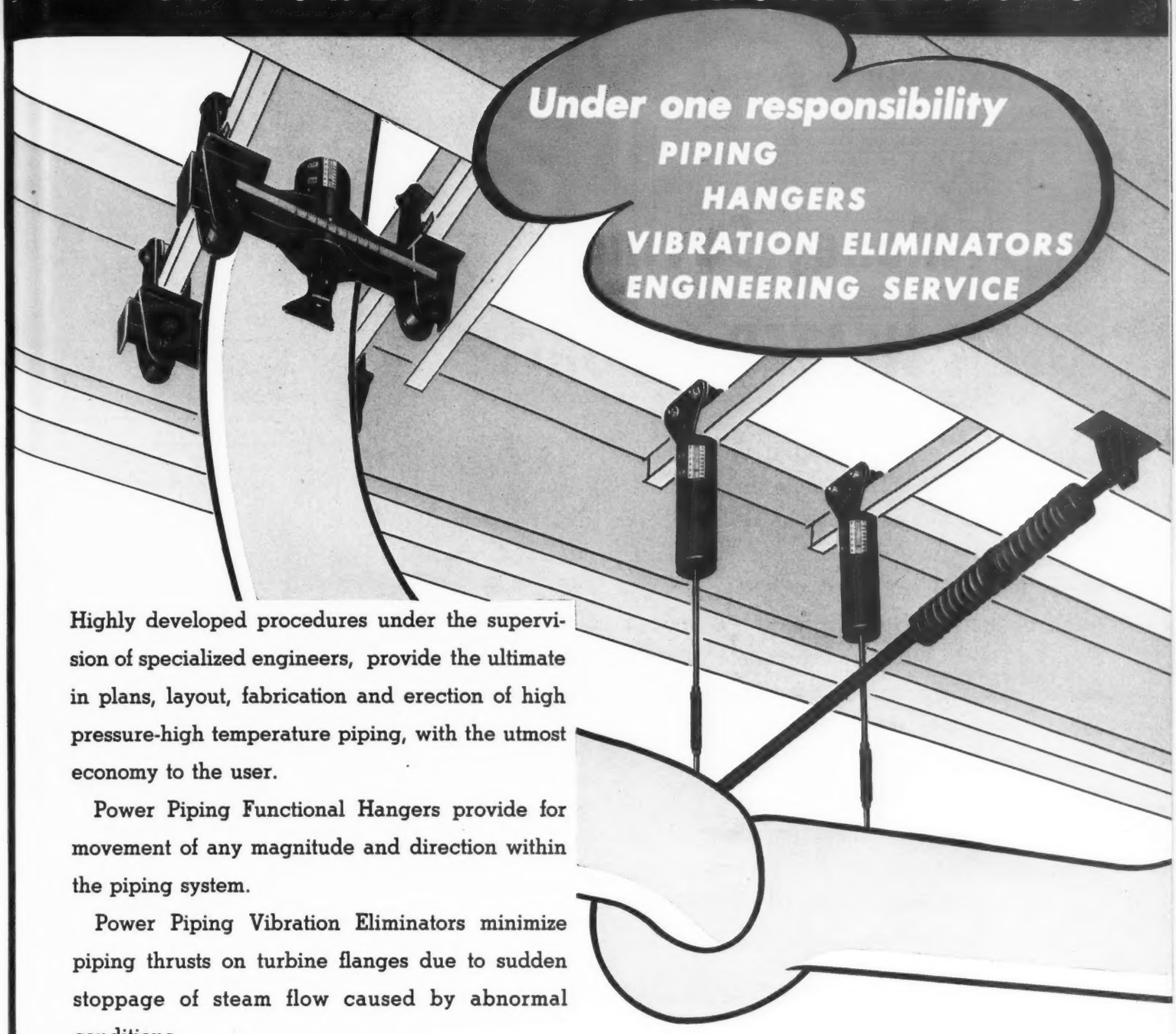
A W THORSON, assistant fuel service engineer for the Chesapeake & Ohio Railway for the last two years, has been appointed assistant to the president of Carnegie Institute of Technology. He will assist the president, Robert E Doherty, in the coal research laboratory, and will also aid in general business operations.

PETER VOSS has retired from the Timken Roller Bearing Co at Canton, Ohio. Mr Voss completed a 24-year period of service with the company. He first served as a clerk in the purchasing department.

STUART J SAKS has been elected president of the Morris Machine Works, Baldwinsville, N. Y. Mr Saks is a graduate of Syracuse University, and following an extensive sales and management

(*Continued on page* 170)

A PERFECT SYSTEM FOR FLEXIBILITY IN POWER PIPING INSTALLATIONS



Highly developed procedures under the supervision of specialized engineers, provide the ultimate in plans, layout, fabrication and erection of high pressure-high temperature piping, with the utmost economy to the user.

Power Piping Functional Hangers provide for movement of any magnitude and direction within the piping system.

Power Piping Vibration Eliminators minimize piping thrusts on turbine flanges due to sudden stoppage of steam flow caused by abnormal conditions.

Public Utilities are standardizing on Functional Hangers and Vibration Eliminators because they increase the life of the entire installation, eliminate repetition of stress and generally function as insurance to minimize operating hazards in high pressure piping systems.

On receipt of sketch or prints showing any piping system, we will gladly recommend the proper hanger and vibration eliminator layout without obligation.

A copy of "Flex-Anal Charts" will be sent to any engineer asking for it on his business letterhead.

•

Send for Bulletin entitled Power Piping Functional Hangers and Vibration Eliminators.

BLAW-KNOX COMPANY
POWER PIPING DIVISION
1525 PENNSYLVANIA AVE., PITTSBURGH, PA.

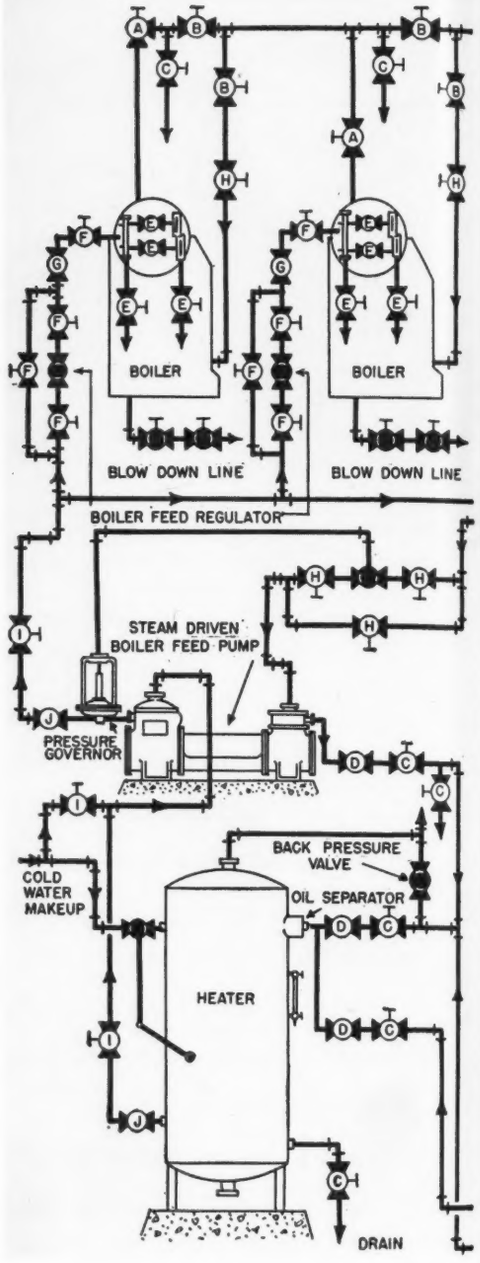
FROM GOOD VALVE DESIGN.

TRADE JENKINS MARK
Jenkins Bros

Money-Saving
OPEN HEATER HOOK-UP

In this steam engine plant, full advantage has been taken of the economies made possible by the use of a condenser. But another element has been added – an open heater – which introduces further economies by utilizing the exhaust from steam-driven auxiliaries to heat the feedwater. Besides assuring a steady supply of warm, air-free feedwater for the boilers, this recovery of waste heat overbalances the high steam-consumption of small steam-driven units. Thus, it creates a thermally-efficient arrangement, wholly independent of outside electric-power supply, even for starting-up the auxiliaries. Through ingenious engineering, the makeup can be added either at the heater or at the condenser hotwell.

To get the best and most dependable results from this or any other plant in *actual practice,* you need the best and most dependable valves. Specify *Jenkins Valves.* Because Jenkins Valves last longer – give more reliable service – and cost *less* for maintenance.



TYPICAL JENKINS VALVES USED IN THIS HOOK-UP

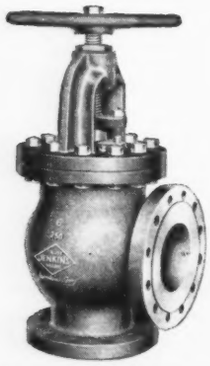


Fig. 293 IBBM Non-Return Automatic Equalizing Stop and Check

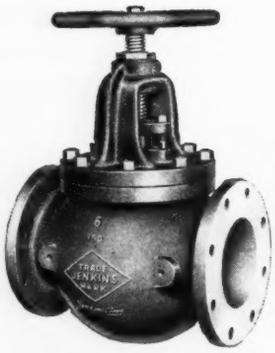


Fig. 142 IBBM Globe Renewable Composition Disc

Fig. 295 IBBM Swing Check Renewable Composition Disc

Fig. 962 Bronze Swing Check Regrinding Bronze Disc

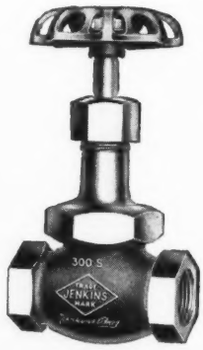
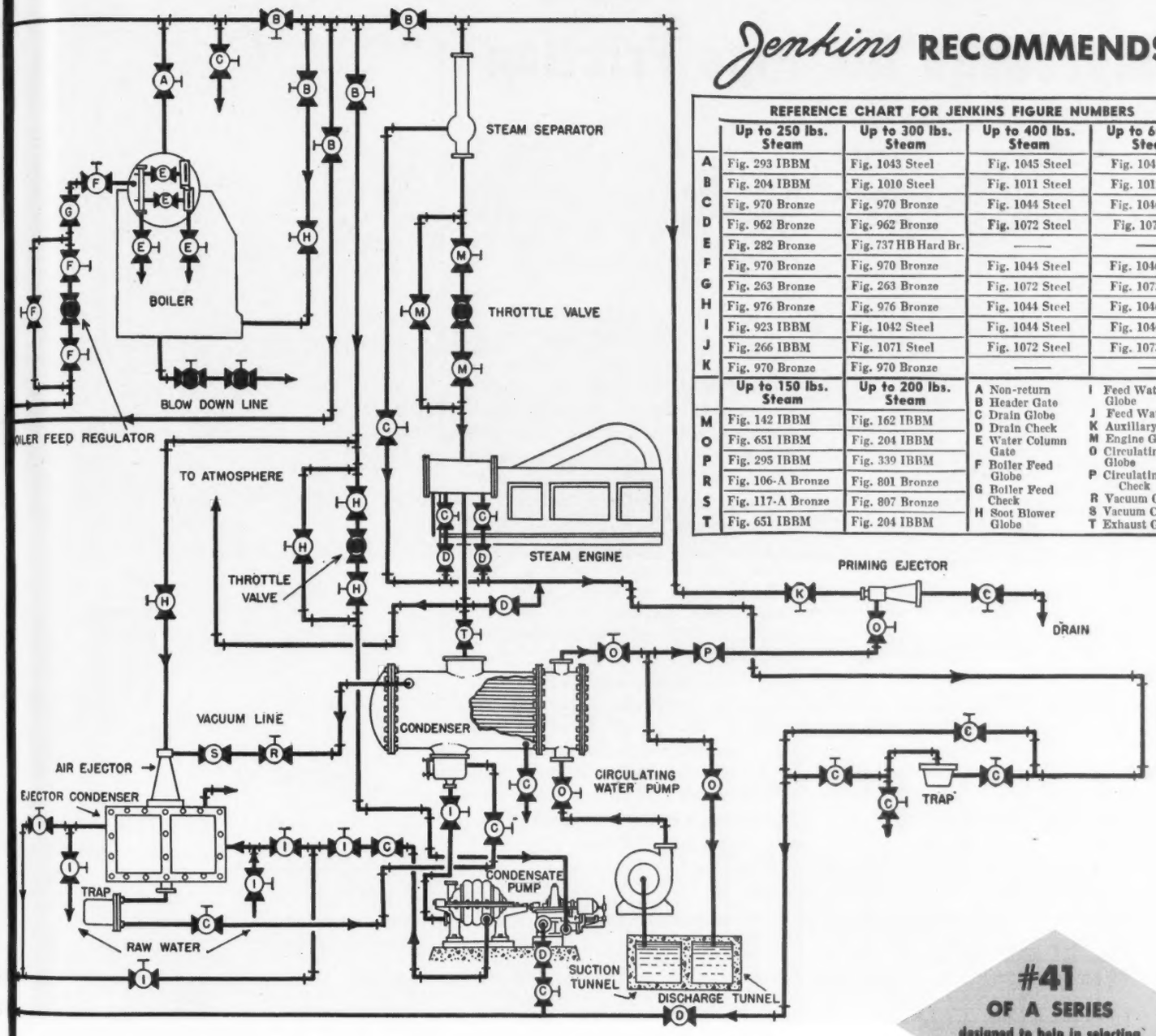


Fig. 976 Bronze Globe Stainless Steel Plug and Seat

JENKINS VALVES for every need

TO GOOD VALVE *PRACTICE*



Jenkins RECOMMENDS...

REFERENCE CHART FOR JENKINS FIGURE NUMBERS

	Up to 250 lbs. Steam	Up to 300 lbs. Steam	Up to 400 lbs. Steam	Up to 600 lbs. Steam
A	Fig. 293 IBBM	Fig. 1043 Steel	Fig. 1045 Steel	Fig. 1047 Steel
B	Fig. 204 IBBM	Fig. 1010 Steel	Fig. 1011 Steel	Fig. 1012 Steel
C	Fig. 970 Bronze	Fig. 970 Bronze	Fig. 1044 Steel	Fig. 1046 Steel
D	Fig. 962 Bronze	Fig. 962 Bronze	Fig. 1072 Steel	Fig. 1073 Steel
E	Fig. 282 Bronze	Fig. 737 HB Hard Br.	——	——
F	Fig. 970 Bronze	Fig. 970 Bronze	Fig. 1044 Steel	Fig. 1046 Steel
G	Fig. 263 Bronze	Fig. 263 Bronze	Fig. 1072 Steel	Fig. 1073 Steel
H	Fig. 976 Bronze	Fig. 976 Bronze	Fig. 1044 Steel	Fig. 1046 Steel
I	Fig. 923 IBBM	Fig. 1042 Steel	Fig. 1044 Steel	Fig. 1046 Steel
J	Fig. 266 IBBM	Fig. 1071 Steel	Fig. 1072 Steel	Fig. 1073 Steel
K	Fig. 970 Bronze	Fig. 970 Bronze	——	——
	Up to 150 lbs. Steam	**Up to 200 lbs. Steam**		
M	Fig. 142 IBBM	Fig. 162 IBBM		
O	Fig. 651 IBBM	Fig. 204 IBBM		
P	Fig. 295 IBBM	Fig. 339 IBBM		
R	Fig. 106-A Bronze	Fig. 801 Bronze		
S	Fig. 117-A Bronze	Fig. 807 Bronze		
T	Fig. 651 IBBM	Fig. 204 IBBM		

A Non-return
B Header Gate
C Drain Globe
D Drain Check
E Water Column Gate
F Boiler Feed Globe
G Boiler Feed Check
H Soot Blower Globe
I Feed Water Globe
J Feed Water Check
K Auxiliary Globe
M Engine Globe
O Circulating Water Globe
P Circulating Water Check
R Vacuum Globe
S Vacuum Check
T Exhaust Gate

JENKINS Bronze, Iron, Steel Valves to meet every need

A glance through the Jenkins Catalog shows that you can specify "Jenkins" for practically every phase of commercial, industrial, engineering and plumbing and heating needs. The line of over 600 valves includes:

Iron, Bronze, Cast Steel and Corrosion-resisting-alloy Gate, Globe, Angle, Cross, Y and Check valves... with composition, bronze, nickel alloy, iron and steel disc or plug... in solid wedge, split wedge, double disc-parallel seat and double disc-taper seat types... in inside screw and OS&Y patterns... with non-rising, traveling, rising and sliding spindle... conventional, quick-opening and rapid action... with screw-in, screw-over, union and bolted bonnet... with screw, flanged, union and solder ends... to meet Underwriters', AWWA, ASME and Marine specifications... for pressures from 125 to 600 pounds... for steam, air, oil, water, gas, chemicals, solvents and other fluids.

All are made to the standard of quality which has given Jenkins Valves the reputation of being "cheaper in the long run". Yet, with two exceptions, they cost no more to buy than other good valves.

AVAILABLE THROUGH GOOD SUPPLY HOUSES EVERYWHERE

#41
OF A SERIES
designed to help in selecting
JENKINS VALVES

JENKINS BROS., 80 White St., New York, N. Y.; Bridgeport, Boston, Atlanta, Philadelphia, Chicago, Houston. Jenkins Bros., Limited, Montreal, Canada; London, England.

REG. U.S. PAT. OFF.
TRADE JENKINS MARK
Jenkins Bros

d Built Better but PRICED NO HIGHER

Number 116

Compressed Air Pipe Friction

▶To determine pressure drop of air or gas at a given temperature through a pipe of known diameter and length, first assume a trial value of the pressure drop for calculation purposes. Subtract half of this value from the initial pressure to obtain a trial value of mean average pressure throughout the length of the pipe.

From the rate of flow in cubic ft per min (measured at standard conditions of 14.7 lb absolute and 60 F) and the pipe diameter, determine the factor f from the chart.*

The pressure drop per thousand feet of pipe can then be calculated from the following formula:

$$p = \frac{f}{P} \times \frac{T + 460}{520} \times G$$

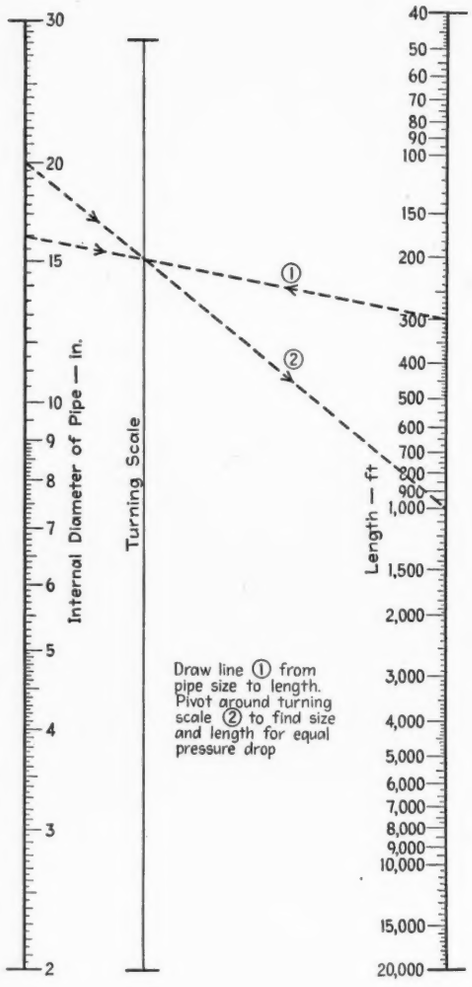
where p — pressure drop per 1000 ft, lb
f — friction factor from chart
P — average pressure, lb
T — temperature, F
G — specific gravity of gas, air = 1

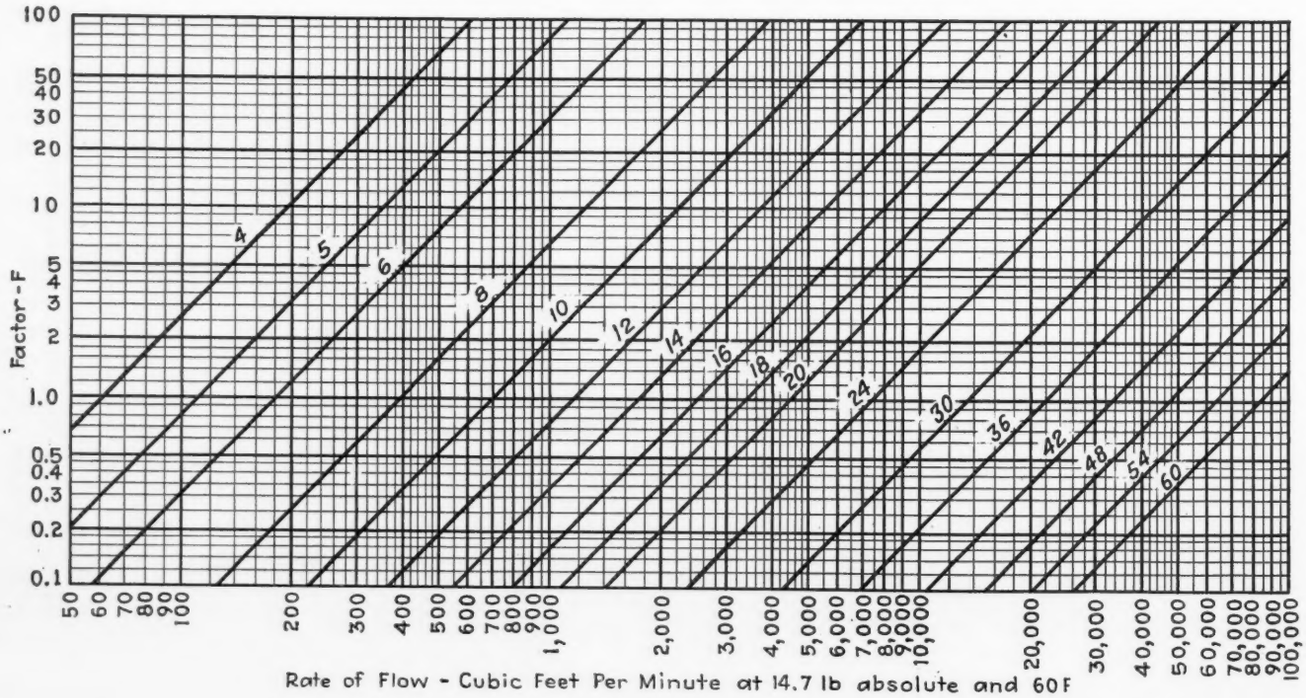
Example: 20,000 cfm of air (standard conditions) flow through 2000 ft of 20-in. pipe at a temperature of 100 F and an initial pressure of 10 lb gage. From the chart $f = 20.0$. Assuming a trial pressure drop of 2 lb. the average absolute pressure is $10 + 14.7 - (\frac{1}{2} \times 2) = 23.7$. Then:

$$p = \frac{20.0}{23.7} \times \frac{560}{520} = 0.91 \text{ lb per 1000 ft}$$

and 2000 ft of pipe would have a pressure drop of 1.82 lb. If this pressure drop does not agree closely with the trial value, recalculate a more nearly correct average pressure and obtain a new value of the pressure drop.

For lines made up of different sizes of pipe, calculation is simplified by use of the second chart to reduce the several sections to equivalent lengths of one standard diameter. For example, 300 ft of 16-in. pipe would have the same pressure drop as 980 ft of 20-in. pipe. Pressure drop through 2000 ft of 20-in. pipe (example above) plus an additional 300-ft of 16-in. pipe carrying the same flow would be figured in a single step as follows: $(2000 + 980) \times 0.91$ lb per 1000 ft $= 2.7$ lb. *By H Gartmann, De Laval Steam Turbine Co.*


Internal Diameter of Pipe — in.
Turning Scale
Length — ft
Draw line ① from pipe size to length. Pivot around turning scale ② to find size and length for equal pressure drop



* Computed from U. S. Bureau of Mines Report 3153.

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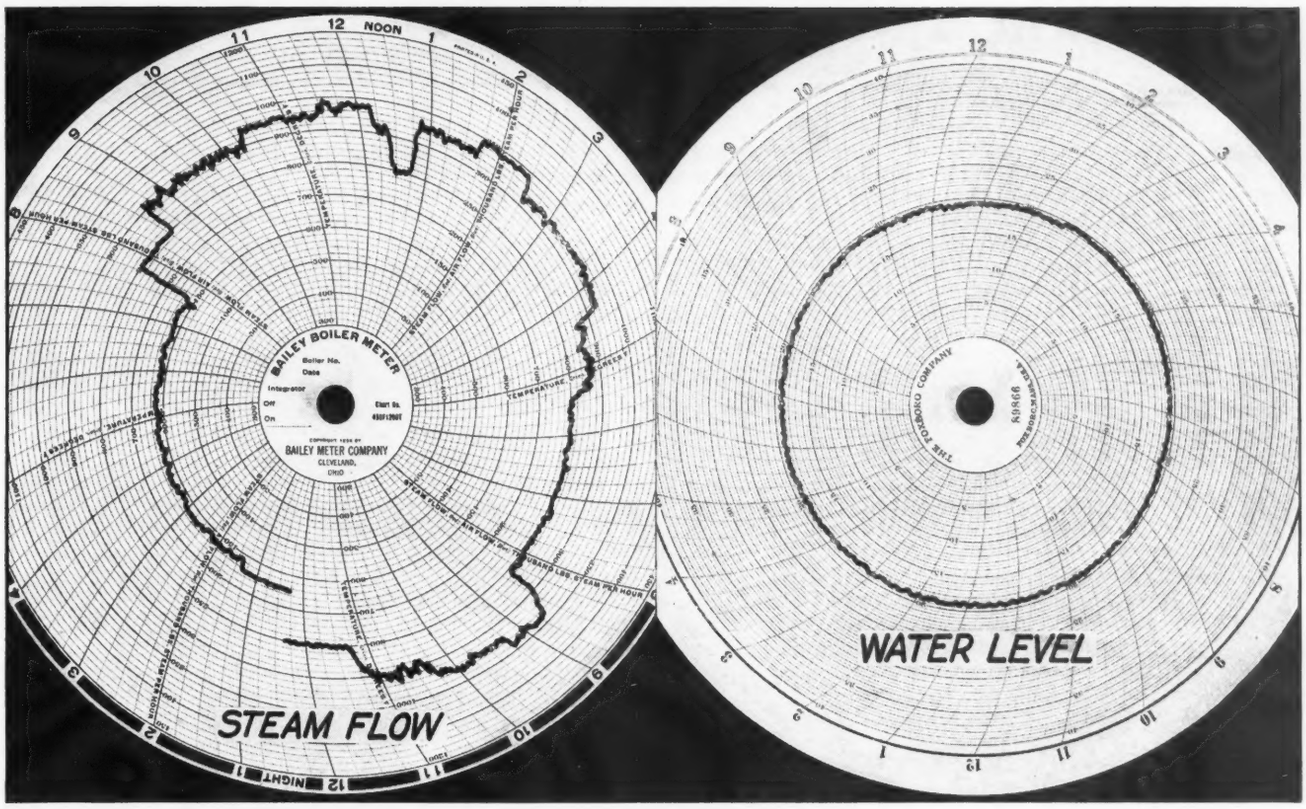


These charts show why 7 plants in this utility system use Flowmatic

This utility system first installed COPES Flowmatic in 1937. Now seven of its plants are using this simplified two-element steam-flow type feed water regulator on 875-pound pressure boilers, with capacities from 400,000 to 550,000 pounds per hour. Nine repeat orders have been placed. The charts show why.

This Foster Wheeler 3-drum boiler normally evaporates 330,000 pounds per hour, with maximum load of 400,000 pounds. Fired with powdered coal, total temperature is 860 degrees F. The motor-driven centrifugal pump has no automatic pressure control, yet the water level is held within less than plus or minus one inch by the COPES Flowmatic.

Want to know how this new COPES operates—where it is used—what results others are getting in regular service? Then write for Bulletin 429. It's worth your study!

NORTHERN EQUIPMENT COMPANY

421 GROVE DRIVE, ERIE, PA.

Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Reducing Valves and Desuperheaters

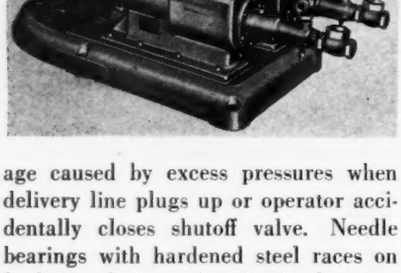
★ GET CLOSER LEVEL CONTROL WITH THE COPES FLOWMATIC ★ REGULATOR

FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY

WHAT'S NEW IN PLANT EQUIPMENT

Adjust-O-Feeder

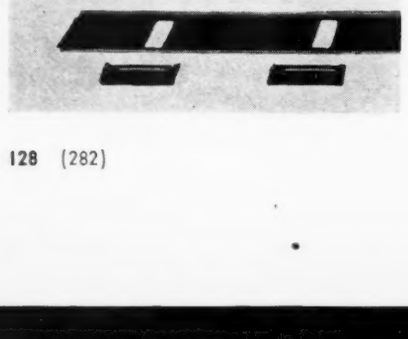
PROPORTIONEERS ADJUST-O-FEEDERS are now being equipped with cylinder support frame carrying new fluid sealed yoke as well as incorporating features outlined below. These include micrometer stroke adjustment feature, consisting of micrometer screw in slotted crank having large knurled thumb nuts at each end for easy and exact positioning of crankpin throw and displacement capacity. Driving crank is equipped with shear pin to protect speed reducer, which drives unit, against dam-



age caused by excess pressures when delivery line plugs up or operator accidentally closes shutoff valve. Needle bearings with hardened steel races on both crankpin and wristpin bearings included. Equipped with oversize tubular crosshead and crosshead guide, with drip-feed lubrication. Stroke indicator scale is mounted on crosshead frame and directly attached to extension of displacement plunger. Fluid sealed yoke (not shown in illustration) permits the use of inclosing fluid around plunger and stuffing gland. Extra-deep stuffing box with replaceable bushing allows for depth adjustment. *Proportioneers, Inc, Providence, R. I.*

Bus Duct

COMPOSED OF COPPER BUSSES, Prestite separators, and a dust-tight metal inclosure, the unit is available in ratings of from 250 through 1400 amp. At currents below 1500 amp hot-rolled sheet steel is used; at values of 1500 amp or over, a feeder duct of different construc-



tion is available. Plug-in sections in the bus duct are supplied with 10-ft line units with outlet service staggered every 12 in. along a run. Outlet receptacle covers are not removed, but simply slide along duct to expose plug-in connections (see illustration in first column). *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

Commutator Stone

EXCESS FILM and dirt caused by heavy, continuous power loads can be easily and quickly removed from commutators with cleaning stone. "Ideal" stone cleans while the motor or generator is running, and is used by simply holding it against the commutator and moving it slowly across the face. Said not to clog or cut commutator, and also cleans film from the brush sets and helps reseat brushes. Cleaning stone also said to improve brush performance—reduce noise, even distribution of brush-contact drop and brush wear, reduce chattering and sparking. *Ideal Commutator Dresser Co., 1025 Park Ave., Sycamore, Ill.*

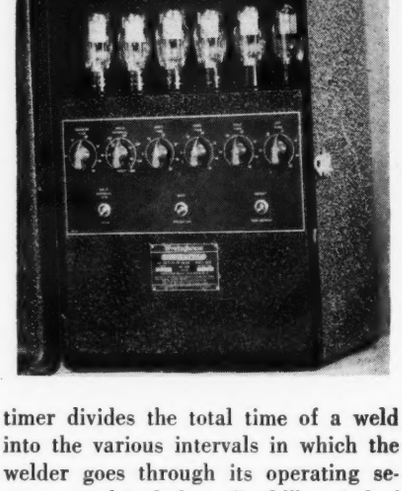
Valve Control

NEWLY DESIGNED UNIT for manual control of remote valves, dampers, and other pneumatically operated equipment announced by company. In appearance,

unit harmonizes with the rectangular case in which Foxboro recording and controlling instruments are now available. When flush-mounted, its front surface is only $\frac{1}{16}$ in. from the instrument-panel surface. Specifically designed for dead-end service, valve control unit will hold reduced pressures dependably to values within narrow limits. The unit is practical, maker says, for operation over distances as great as 1000 ft. *The Foxboro Co, Foxboro, Mass.*

Sequence Timer

WELD AND SEQUENCE TIMER is for automatic resistance spot, butt or projection welding. Timing circuit is fully electronic and consists of a resistor capacitor circuit whose charging rate is adjustable by varying a resistor. The circuit voltage is applied to the grid of a thyratron tube so that after a predetermined charging time has elapsed the thyratron is energized and operates the relay. The

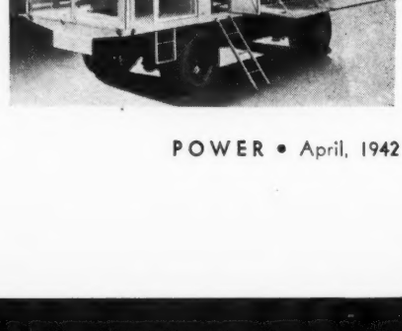


timer divides the total time of a weld into the various intervals in which the welder goes through its operating sequence and includes a "weld" period of 3 to 30 cycles when full welding current flows. When welding thick plates, brass, or stainless steel, timing facilities permit intermittent heating and cooling steps of from 3 to 30 cycles. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

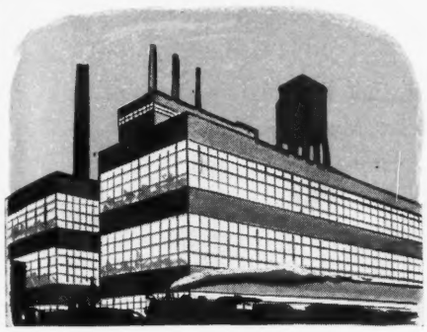
Mobile Generating Plants

EACH MOBILE UNIT CARRIES two 50-kw Ready-Power international diesel electric plants, switchboard, fuel oil storage tank, electric fuel-transfer pump, lubricating oil rectifier, starting batteries, station transformer, and both ac and dc lighting system, and, a substation with transformer, lightning arrestors

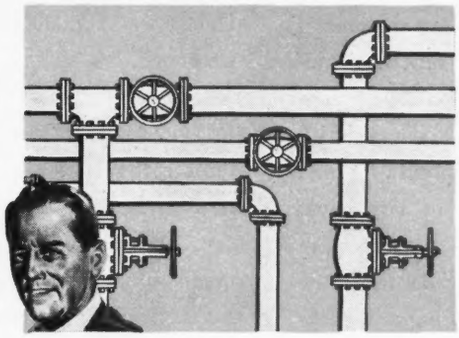
(*Continued on page* 134)



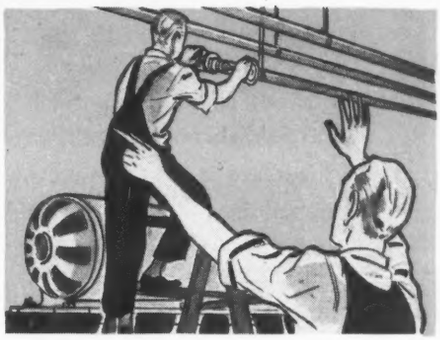
These "Pointers" Made a Tough Training Job Easier!



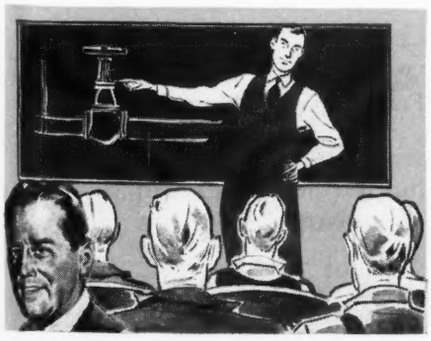
1 With the plant running 168 hours a week, we needed more and better maintenance—day and night! On piping, for example, you can't get away with part-time maintenance and keep production lines running smoothly. It's too important!



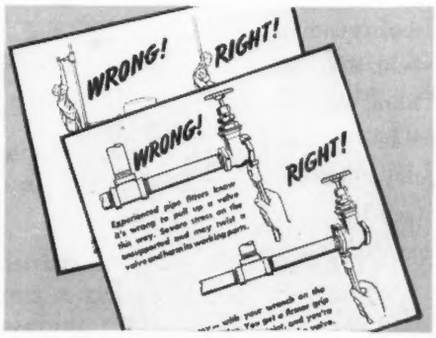
2 Soon enough, we found valves and fittings would have to be handled with unusual care to get every last bit of service out of them. They're vital equipment, and with all the demands of war, deliveries of replacements were being slowed up.



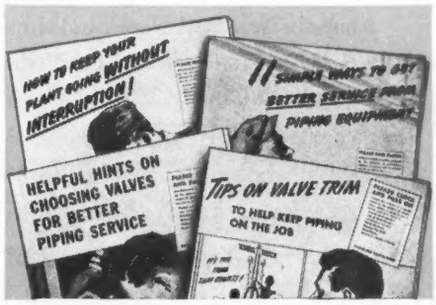
3 Sure, we put on more "maintenance" men, but many had never handled a wrench before. We had to start from scratch in training them. In the past, our veteran crews had the time to teach apprentices, but that was "before Pearl Harbor."



4 You know that piping maintenance is a specialized job. But, it's knowing the "kinks" of the trade that makes the difference between good and bad installation. They help speed-up the work as well as step-up efficiency of pipe lines.



5 We had to teach these men the "rights and wrongs" of piping make-up. We had to be sure they knew enough about valves of all types, and when and where to use them. Good piping depends a lot on using the right equipment.


HOW TO KEEP YOUR PLANT GOING WITHOUT INTERRUPTION!
11 SIMPLE WAYS TO GET BETTER SERVICE FROM PIPING EQUIPMENT
HELPFUL HINTS ON CHOOSING VALVES FOR BETTER PIPING SERVICE
TIPS ON VALVE TRIM
TO HELP KEEP PIPING ON THE JOB

6 These Crane Shop Bulletins made a tough training job easier. They're full of valuable piping pointers. We used them in our employee training classes; posted them in maintenance shops; and passed them among the men. Even the old-timers use them. **And listen, any plant can get these Bulletins free—through the local Crane Representative.**

CRANE

CRANE CO., GENERAL OFFICES:
836 S. MICHIGAN AVENUE, CHICAGO

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS

Too Little - Too Late . . . .

As I write these lines, the once-proud $60,000,000 liner *Normandie* lies on her side in the waters of the Hudson River. Officials hastened to report that no sabotage was involved. But District Attorney Hogan added eight important words, *"Carelessness has served the enemy with equal effectiveness."*

The report is that the fire was started by a spark from an oxyacetylene torch, which struck bales of kapok mattresses and life preservers. Important is the fact that the "dynamite"—inflammable materials—was ready and waiting. The spark was incidental. It might just as well have come from a blowtorch, electrical circuit, or a scuffed match.

Fires are a normal part of shipbuilding and ship refitting—during the building of any naval vessel there are six to seven "fires" a day from various causes. But none do any damage—the "security watch" promptly puts them out and there is nothing nearby to help them grow. Any torch user in industry also knows the prevalence of such fires.

A naval friend of mine tells me that the *Normandie* fire is not in the least unusual. In the last score of years there have been at least a dozen similar ones in New York docks and shipyards, each ending in destruction of the ship. Most recent was the burning of the *Panuco*, where sisal fibre was the "dynamite." He discovered some years ago that the shipfitters actually could afford to employ one extra man for each torch user, with no other job than watching—and could pay that watcher $50,000 a year and save money.

But, apparently, Experience has a difficult teaching job on this particular hazard. Her latest lesson is the loss of a ship that alone could handle a whole division of troops at 30 knots—that might have taken 100,000 of our men anywhere in the world yet this year. And those men are desperately needed!

Is this characteristic of a democracy—that we must learn every lesson the hardest possible way? Can we not, as a nation, derive enough experience from Pearl Harbor and the loss of the *Normandie* to prevent further disastrous results of complacent carelessness—at least until this war has been won? Unless we soon do, the winners will not be those we hoped.

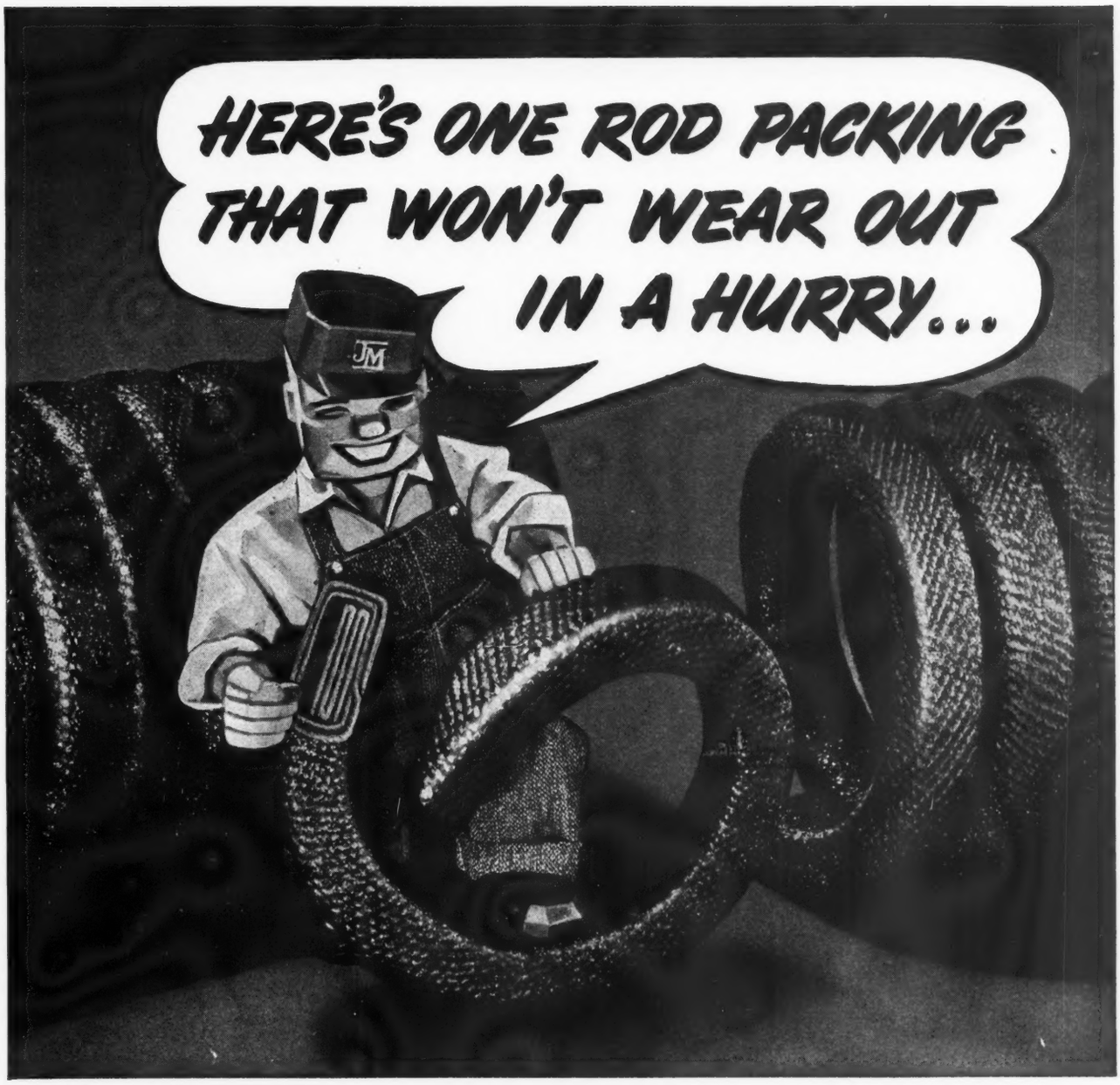
Our current losses are not limited to ships, to fires, or to surprise attacks. Much more serious are the direct results of the carelessness of each of us. In twelve months, industrial accidents—that is to say, *carelessness*—cost America a billion and a half man-hours, enough working time to build 45 battleships, 195,000 light tanks, or 15,000 heavy bombers. And time itself is now the premium item!

Each of us, and all of us, should derive from these statistics the lesson they contain—that "accidents" *must not happen*. Their frequency, and the amount of time they cost, can be drastically reduced if each man takes it as his personal responsibility to prevent them.

That alone would be a major factor in avoiding the dreadful results of France's policy of "too little —and too late."

George Edwards

Engineer



J-M KEARSARGE LASTS LONGER . . . CUTS RE-PACKING COSTS

For continued efficient service against high-pressure steam, you can't beat this rugged rod and plunger packing.

Its unique folded construction provides natural resiliency and forms a reservoir for the preserving lubricant, keeping the packing pliable in service. Additional resiliency is provided by a red rubber expansion back in the center block. And resistance to wear is assured by a double wrapping of asbestos cloth.

You can use Kearsarge Rod Packing, together with other packings and gaskets in the complete Johns-Manville line, to minimize equipment shutdowns . . . save much of the expense and loss of production caused by too-frequent *re*-packing. For details, ask for the new J-M Packing Catalog. Johns-Manville, 22 East 40th St., New York, N. Y.

JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

THERE'S A DISTRIBUTOR NEAR YOU

TOO OLD TO WORK?

NOT A DART UNION!

PUT YOUR USED DARTS BACK ON THE JOB

A Dart Union can be used again, again, and again, with full assurance of getting tight, dependable joints each time. Yes, even a Dart you *thought* was through can be put back to work.

That's why we are suggesting, in the interest of metal conservation, that you make a search of your plant for used or discarded Dart Unions —and put them back on the job.

There are good solid reasons why Dart Unions offer such outstanding performance and reach such a ripe old age. For one thing, Darts have matched bronze inserted seats, precision machined and ground to an accurate true ball joint. Also, Dart bodies and nuts are extra heavy, made of air refined malleable iron that resists corrosion and is proof against pipe strains and wrench abuse.

So—get the *extra* value from your used Darts. Use them again. And see your supplier today to get extra-value *new* Darts.

DART UNIONS

E. M. DART MFG. CO., PROVIDENCE, R. I.

Voltage Regulation

(*Continued from page* 64)

poor brush contact, brushes not on neutral of exciter commutator, minor grounds on windings, and prime-mover-governor sluggishness.

4. Generators must have proper electrical characteristics to cope with the magnitude and duration of load changes. The generating equipment is largely responsible for good voltage regulation, because all a voltage regulator can do is move immediately after a voltage change to insert or remove the correct amount of resistance in the field circuit. The rest is up to the rotating apparatus and the results are largely dependent on the time constants and inherent magnetic lag. High-speed machines usually have high speed-response characteristics, while slow-speed machines are usually slow in response.

A regulator is primarily an automatic rheostat which changes the resistance in the exciter-field circuit in accordance with voltage changes on the generator as previously mentioned. It will increase system stability and relieve the burden of rheostat adjustments from the station operators.

In servicing regulators, it must be remembered that satisfactory operation cannot be obtained until the equipment which the regulator controls functions correctly. Then the servicing consists of simple adjustments at the time of installation, and periodic inspection.

Small-town Diesels

(*Continued from page* 73)

Another possible source of contamination is blocked by impingement filters on the air intake. The 500-hp unit is pump-scavenging, with a built-in pump to send air under a slight pressure to the cylinders. This, of course, makes for complete scavenging and assures the cylinders a full charge of fresh air. Air for this unit is drawn through a stack outside into an enclosure that houses the 6-unit air filter. The filtered air then goes to the scavenging pump. Exhaust gas vents through a vertical silencer outside the building. Either of two 3¾x3-in. compressors, one motor- and one gasoline-engine-driven, supply starting air.

A compact panel holds pressure gages for lube oil, cooling water, scavenging

WHY CHAPMAN'S LIST 960

"CHEATS the UNDERTAKER"

longer than any similar Small Valve

EXTRA LIFE is built into this small forged-steel gate valve with renewable stem, seat rings and wedge of stainless steel *...superhardened by a new, exclusive Chapman Process.* This plus-protection makes every 960 "harder to kill" even under toughest conditions . . . in fact, it will outlive any similar type of small valve. And that goes for pressures up to 800 lb. at 750°, or 1500 lb. cold working pressure. Prove it by your own test, on any line from ¼" to 2". The Chapman Valve Mfg. Co., Indian Orchard, Mass.

CHAPMAN LIST 960

Forged Steel Gate Valves

"STANDCO" PILLOW BLOCKS

Fig. 1635

Combining clamp box and pillow block requirements in one type, the "Standco" shown at left is sturdily built and is offered in a wide range of sizes. Babbitted bearing surfaces are finished beautifully and both faces are machined. It can be depended on for long, trouble-free service.

WRITE FOR BULLETIN

STANDARD PRESSED STEEL CO.
JENKINTOWN, PENNA. BOX 577
— BRANCHES —
BOSTON • DETROIT • INDIANAPOLIS • CHICAGO • ST. LOUIS • SAN FRANCISCO

Below, a reproduction from an actual untouched color photograph which illustrates the appearance of the gauge glass from directly in front.

"...and be sure they're PYREX"

That's a "must" order from the engineer who has eye-witness evidence of the performance of PYREX Broad Red Line Gauge Glasses.

The one job of a gauge glass is to show water-level—and that's the job PYREX Broad Red Line Gauge Glasses do better than all others.

Look at the illustration at the left. The broad red line fused directly to the wall of the gauge glass *makes* the liquid level stand out. The resistance of PYREX brand Gauge Glasses to the corrosive action of steam insures a long life for that liquid level visibility.

Those qualities, plus machine-drawn accuracy, ability to withstand maximum working pressures, and remarkable resistance to thermal shock make PYREX brand Gauge Glasses the first choice of good engineers. Stocked by leading mill and steam supply dealers.

"PYREX" is a registered trade-mark and indicates manufacture by Corning Glass Works.

CORNING Glass Works Corning, New York

Pyrex Gauge Glasses

air and starting air, and a multi-point exhaust pyrometer. An alarm sounds if either water or lube-oil pressure drops below a predetermined point.

The 6-panel switchboard carries oil circuit breakers and a full complement of meters. A single voltage regulator serves the entire plant. The synchronizer is motor driven.

Three operators on 8-hr shifts care for the plant under the active supervision of G L Skelton, Manager of Utilities. A careful maintenance program avoids breakdowns and holds repair costs to only $.25 per hp per yr.

New Equipment

(*Continued from page* 128)

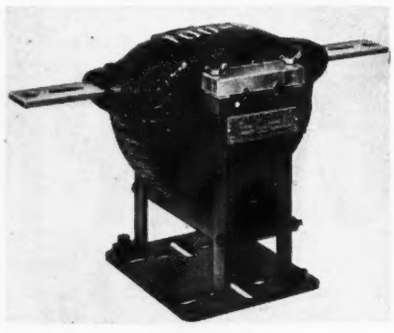
and air break switches. These mobile generating plants can be operated alone or in parallel with other mobile plants, or as boosters in parallel with central station power. They carry their own fuel, have a power-operated fuel supply pump for fuel transfer from tank wagon or other supply source, and are completely muffled and sound deadened for operation in congested districts. *The Ready-Power Co, Detroit, Mich.*

Try Cock

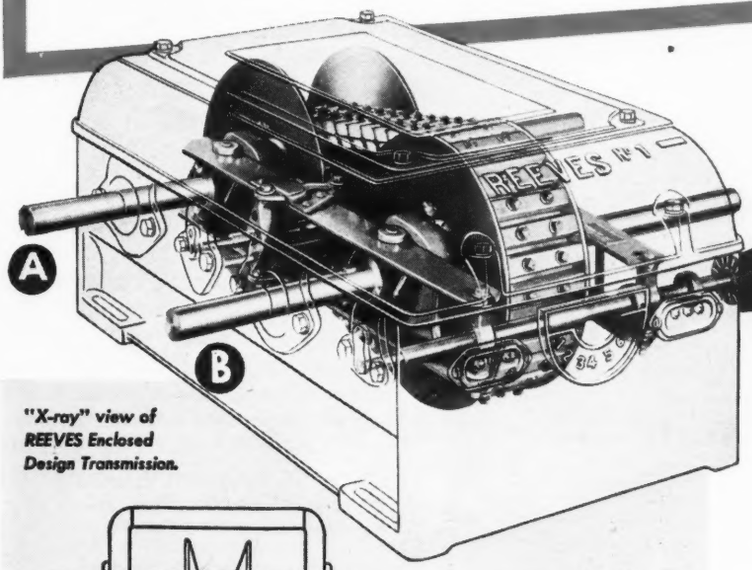
ILLUSTRATION SHOWS YARWAY HEAVY-DUTY TRY COCK, built for high-pressure service. For pressures up to 600 lb body and stem are tobin bronze, for 600 to 1500 lb, these parts are stainless steel, are reversible and renewable. To avoid interference of operating chains, operating lever on upper try cock is offset outward, lever on center unit is straight, and lever on lower try cock is offset inward. *Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.*

Current Transformers

FOLLOWING ADOPTION OF STANDARD primary ratings for current transformers by EEI and NEMA, the company devel-

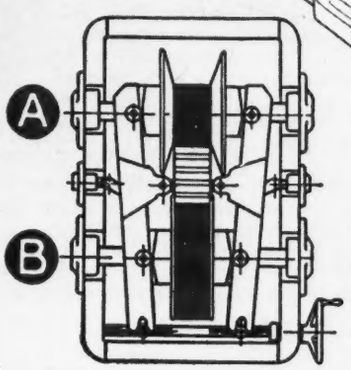


See HOW THE REEVES TRANSMISSION PROVIDES COMPLETE SPEED ADJUSTABILITY . . .



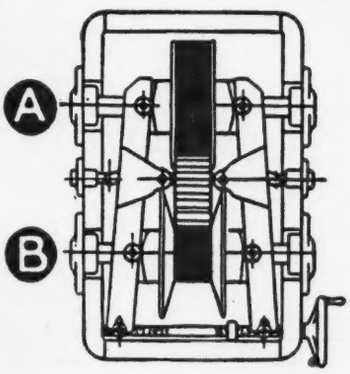
"X-ray" view of REEVES Enclosed Design Transmission.

"One of the best investments we ever made. Your drives have been in operation on our machines for years with negligible maintenance expense," says a Cleveland manufacturer.*



AT MINIMUM SPEED POSITION

On constant speed shaft "A," cone-faced discs and speed-changing levers are *farthest apart* while the V-belt runs at *smallest* diameter between the discs. On variable speed shaft "B" reverse is true and shaft runs at *minimum* speeds.



AT MAXIMUM SPEED POSITION

On constant speed shaft "A," cone-faced discs and speed-changing levers are *closest together* while the V-belt runs at *largest* diameter of the discs. On variable speed shaft "B" conditions are reversed and this shaft runs at *maximum* speed.

The entire speed range is covered smoothly, without steps or jumps, from one speed to another and while the driven machine is in operation. No interrupting production.

You can quickly see by these diagrams how the REEVES Variable Speed Transmission provides any driven machine with infinite speed adjustability.

Design is based on the proved and tested principle of a V-belt driving between two pairs of adjustable cone-faced discs mounted on parallel shafts. One shaft receives power at constant speed from motor, lineshaft, etc. The other, connected to the driven machine, transmits power at infinitely adjustable speeds above and below the speed of the constant speed shaft as the V-belt assumes different diameters of contacts against each set of discs.

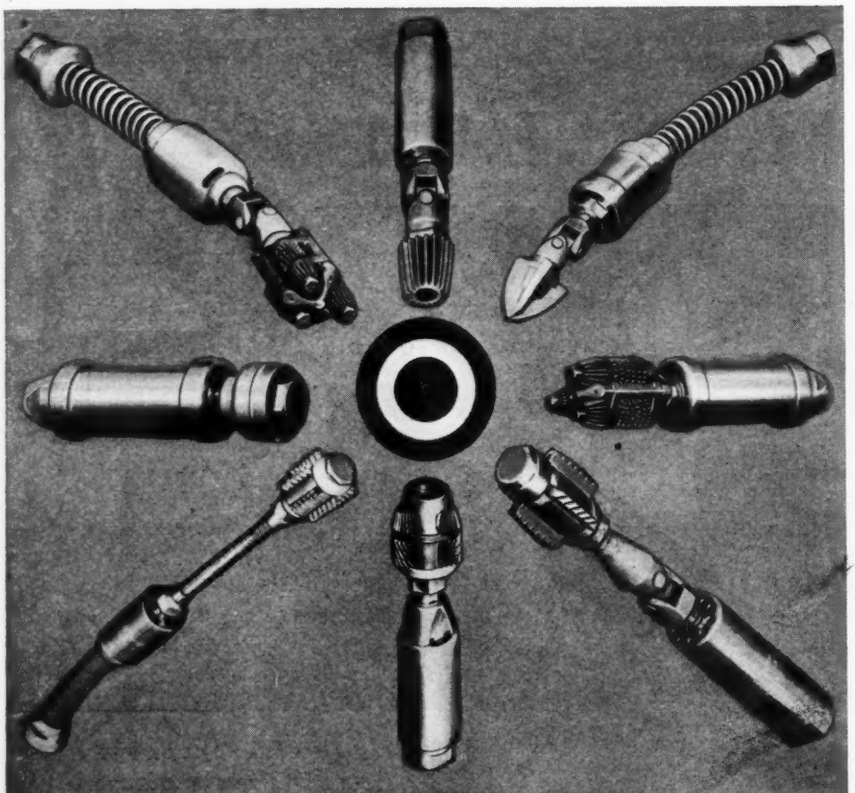
Power is transmitted positively because of non-slipping, wedge-like action of the rugged REEVES endless cord V-belt. Equally important—any speed setting is maintained without fluctuation because *belt tension is automatically controlled at all driving diameters.* With REEVES speed adjustability, positive and accurate over full range, machines can be run at greatest efficiency under every changing condition.

Sizes from fractional to 87 h.p. Speed ratios from 2:1 through 16:1. Vertical and horizontal models. Manual, automatic or electric remote controls for speed changing. Write us.

REEVES PULLEY CO., *Dept. K,* COLUMBUS, IND.

* Name on request.

REEVES *Accurate Variable* Speed Control



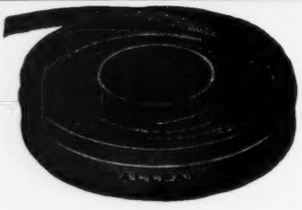
TO SAVE PRECIOUS TIME—
USE WILSON TUBE CLEANERS

Now that we are at war, the production of thousands of essential products *must* be speeded up to the limit for "Time is Short" indeed.

Wilson Tube Cleaners clean *faster, better,* and *more economically* and save time, fuel, labor, tubes, and money, because of their *greater speed, greater power,* and *greater efficiency.* Use the proper Wilson Tube Cleaner and accessory designed to meet the scale condition to be overcome and you will save some of that precious time and increase the production of essential war materials. There is a Wilson Tube Cleaner or accessory for every tube cleaning need.

Write for the name of our representative nearest to you or for a copy of our thirty-six page catalog fully describing and illustrating the complete line of Wilson tube cleaning equipment.

THOMAS C. WILSON, Inc.
PIPE AND TUBE CLEANERS EXCLUSIVELY
47-28 37th Street Long Island City, N. Y.



ALLPAX
THE PACKING THAT "PACKS ALL"
. . . use it once and
. . . you'll use it always

Here's the universal packing that can be used for any fluid or on any apparatus. One size packs all—economically, efficiently—tightly—simply.

Try ALLPAX and you, too, will be enthusiastic over its easy application and long wear. You don't have to remove old packing to repack with ALLPAX. Square cross section makes ALLPAX easy-filling in any stuffing box.

Try it and you'll always use it. Full details on request.

THE ALLPAX CO., INC.
Mamaroneck, N. Y.
•
Distributors Everywhere

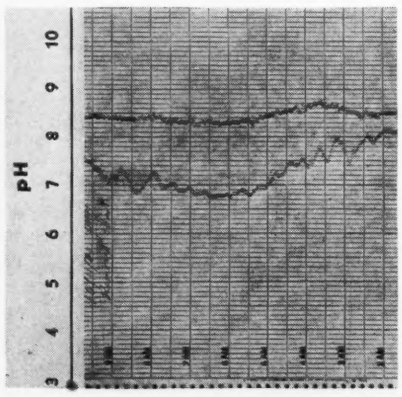
oped three new types of current transformers. Conforming to the standard major dimensions in the three ratings—5 kv, 8.7 kv, 15 kv—the new transformers have standard base dimensions and primary bar heights and dimensions, making possible free interchange of this equipment on all metering installations. *Allis-Chalmers Mfg Co, Milwaukee, Wis.*

Water Conditioning

TECHNICAL WATER CONDITIONING SYSTEM combines advantages of complete supervision and analytical servicing of boiler, feed line, condensers, etc, plus a simplified natural water correction, utilizing individualized Baerite Organic Formulas developed from analysis of water samples and boiler system conditions. These formulas are individual variations of standard formulas previously marketed by the company. Formula variations are assigned special identification, similar to prescriptions, and are supplied to original user only, except where water conditions are duplicated. Regular boiler inspections and recommendations by company experts are part of service. *Water Treatment Company of America, Pittsburgh, Pa.*

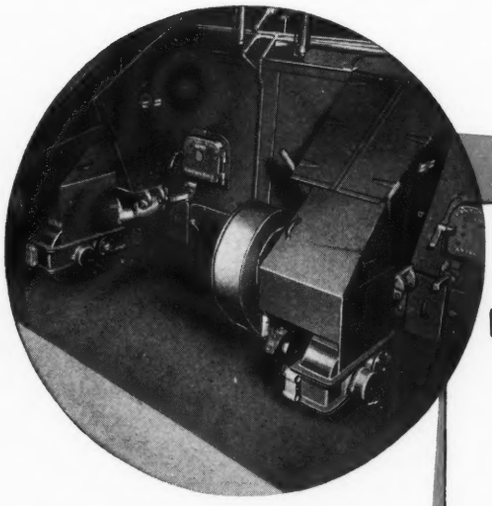
pH Recorder

MULTI-POINT RECORDER simultaneously records pH at separate and independent points in a fluid closed system. The photograph shows actual record from the condensate system of a large large utility generating plant where this system is in operation. The instrument



which provides the pH record at different stages in a process or treating operation is conventional in appearance, but incorporates an advance circuit design and permits installation of the measuring electrodes at separate and independent sampling points in the plant. These are connected electrically to the re-

CANTON STOKER Engineering saves 174 tons of coal..



Above are shown two of the three Canton Stokers that are on the job saving coal (and money) for famous Grove Park Inn at Asheville, North Carolina.

After a careful survey of Grove Park Inn requirements was made by Canton Stoker Engineers, one Worm-feed and two Ram-feed units were installed. These Canton Stokers replaced firing equipment of another make. Immediately, coal consumption dropped from 492 tons to 318 tons—a 174-ton savings!

Perhaps the same money-saving opportunity exists in your steam plant. Our Engineers are offering timely suggestions to many vital industries, suggesting changes that increase capacity and efficiency and reduce fuel bills.

Your request for helpful literature or personal consultation will receive our prompt attention. Write, wire or phone today.

Below is shown cross-section of a Canton Stoker in operation showing method of feeding and burning coal.

GROVE PARK INN

above ASHEVILLE, N.C.

January 1st,
1940

Mr. N. S. Fulford
District Representative,
Canton Stoker Corporation
Canton, Ohio

Dear Sir:

We submit at your request the following data as to our fuel consumption during the months of October, November and December, following the installation of your stokers as compared with the same months as last year.

1937		1938	
Oct.	146 tons	Oct.	148 tons
Nov.	163 "	Nov.	144 "
Dec.	183 "	Dec.	163 "

1939	
Oct.	78 tons
Nov.	119 "
Dec.	121 "

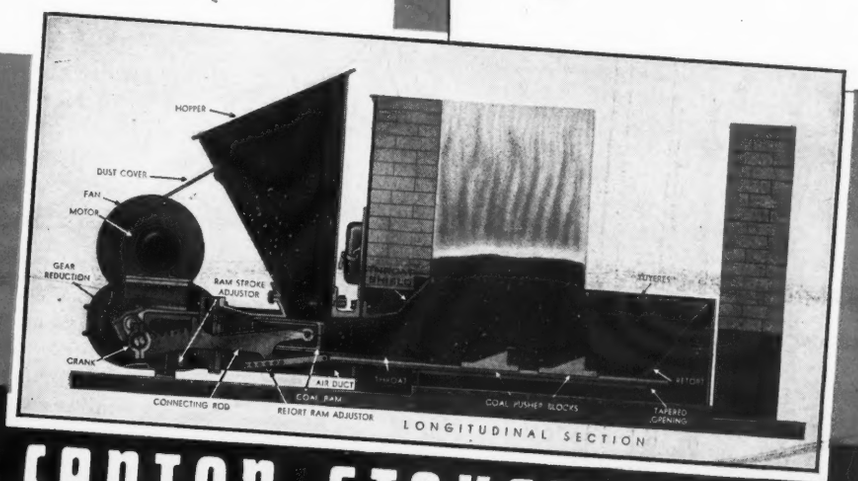
The above figures are taken from the daily record and the reduction shown is attributed to various changes which we made in our heating plant. One of the most contributing factors, I believe to be, is the electric driven Canton Stokers installed. We have three of these stokers, one worm type, operating on our vertical 40 H.P. boiler, and two ram type operating respectively 2 H.R.T., 125 H.P. boilers.

The two ram type stokers are equipped with zone wind boxes and inside dump grates which adds much to our efficiency and greatly reduces the smoke and flyash problems.

Yours very truly,

JPR
IHB

GROVE PARK INN
J. P. Roberts
Engineer



CANTON STOKER

CANTON STOKER CORPORATION

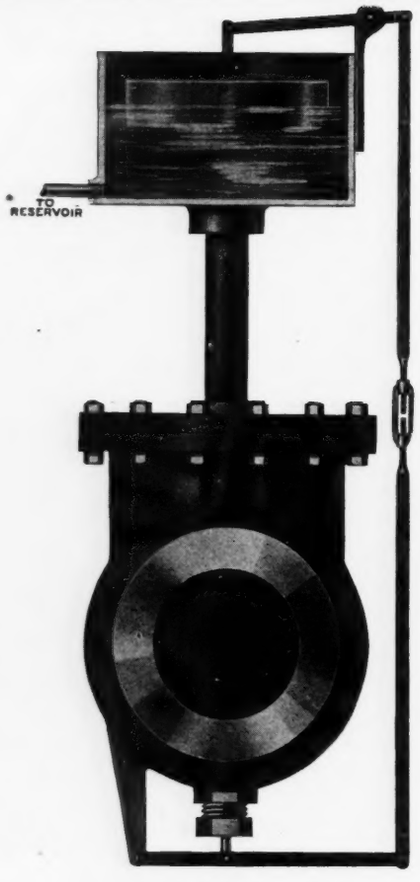
ANDREW PLACE, S. W., CANTON, OHIO

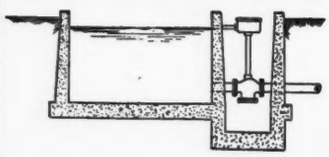
★

Golden-Anderson

SPECIALTY

VALVES





FLOAT CONTROL

● Especially practical and desirable for water level control in mixing chambers, coagulating basins, etc., is the G-A Balanced Controlling Float Valve. It *insures* a maximum water level and a constant rate of flow. In the closed position, this valve will seat absolutely tight, and it is cushioned to overcome any shock or surge. Provided in 3" to 24" sizes, this G-A all-around efficiency valve has flanged ends with iron body and bonnet and bronze trim. Complete and detailed information on the entire G-A line may be had upon request. Write for our latest free catalogs today.

Also ***Altitude Control . . . Pressure Reducing . . . Throttle and Emergency Stop . . . Check Valves etc.***

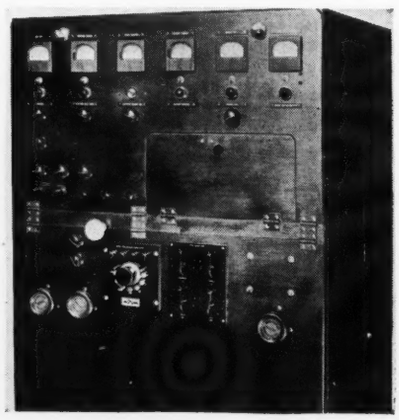
GOLDEN-ANDERSON VALVE SPECIALTY CO.

FULTON BUILDING • • • PITTSBURGH, PA.

corder, which may be located some distance away. Such continuous pH records are said to render it easy to detect changes in operating conditions, making possible output of a more uniform product and elimination of waste. First application of the new recorder was made in the power plant field, where corrosion of boiler system is largely influenced by the pH of the feedwater going to the boiler. *Cambridge Instrument Co, Grand Central Terminal, New York, N. Y.*

Mass Spectrometer

UNIT IS ESSENTIALLY a high-vacuum tube containing electrodes, filaments, slit system, and an electron collector. The gas or vapor to be studied is subjected to bombardment by narrowly defined beam of electrons. The ions thus formed are accelerated through two narrow parallel slits in two parallel plates at a potential difference of from 100 to 1000 volts. The ions emerge from second slit as a narrowly defined beam of nearly the same energy. This beam is then deflected by



a uniform magnetic field designed to sort the ions according to their mass-to-charge ratio. Thus the spectrometer gives directly information about relative abundance of different kind of molecular ion fragments formed when molecules of a particular kind are struck by electrons of known energy. For quantitative indication of gas to be measured, ions strike a metal cup connected to ground through a very high resistance. The voltage developed across this resistor is fed to the grid of an electrometer tube. This amplifies the current so that it can be read with a sensitive galvonometer. The unit is mounted on a rubber-tired truck for complete portability, with only outside connections required being 110-volt ac line for electric power and water connections for cooling the pumps. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

DON'T LET RUST GET A GRIP ON YOUR TURBINES

TESTED, proved in use by leading utilities and turbine manufacturers, *new* Shell Turbo Oil meets *all three* requirements of modern turbine lubrication . . .

RUST PREVENTION
SUPERIOR OXIDATION STABILITY
MINIMUM FOAMING TENDENCY

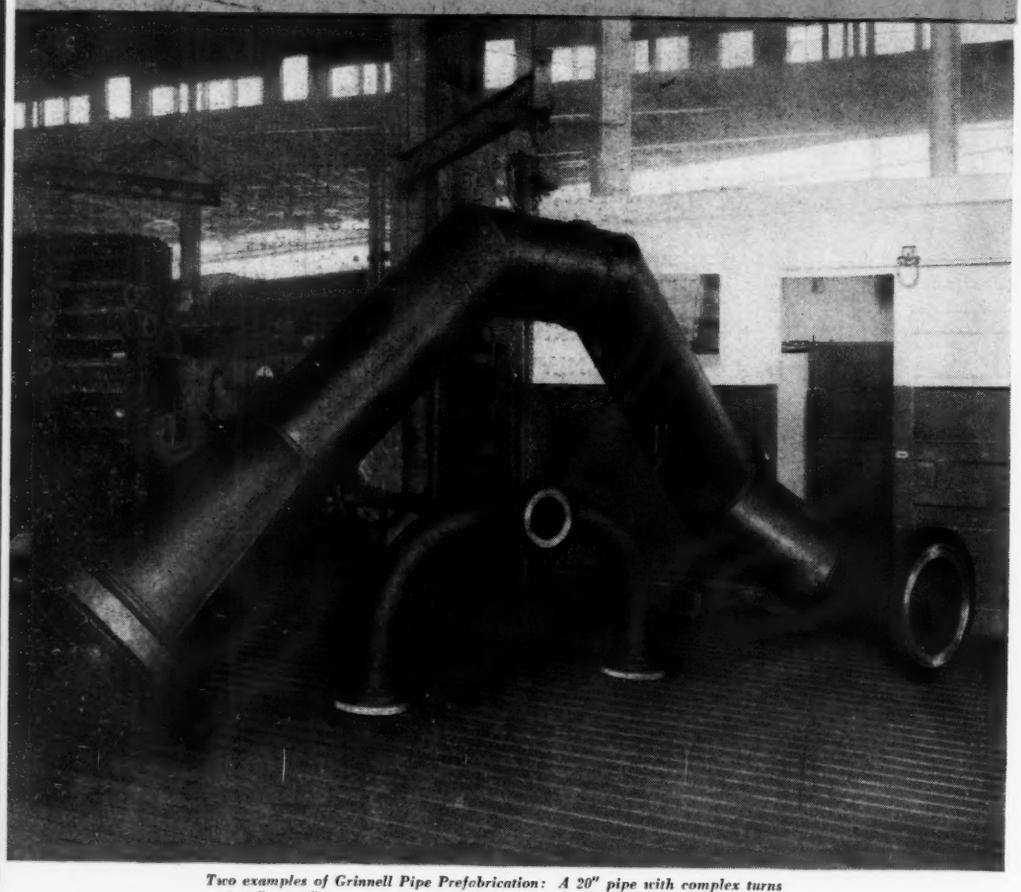
Before you sweeten or drain and change oil, get the details on the *new* Shell Turbo Oil. Call in Shell today!

SHELL

Lubricate with RUST-PREVENTIVE

SHELL TURBO OIL

SHORT-CUT TO "ENOUGH... IN TIME!"



Two examples of Grinnell Pipe Prefabrication: A 20" pipe with complex turns and 20" x 32" increaser for handling hot oil in one of the new Houdry Process oil refineries . . . and an engine header involving 24"-radius U-bend.

Sub-contract your piping worries!

Here's a practical "way out" for power and process engineers who are overloaded with the added work of wartime plant extensions! A way to delegate an exacting job, yet *know* you'll get first class results!

"Give the Plans to Grinnell" as soon as your special piping requirements are roughed out. Grinnell engineers are specialists equipped by long experience to interpret power and processing layouts into superpiping systems for any industry. Grinnell plants, strategically located to serve all industries, have complete prefabrication facilities to produce underwriter-approved sub-assemblies that permit speedy erection.

Learn how such sub-contracting can ease your job of providing facilities to produce "enough . . . in time"! Write for booklet "Grinnell Piping Prefabrication". Grinnell Company, Inc., Executive Offices, Providence, R. I. Branch offices in principal cities of U. S. and Canada.

PREFABRICATED PIPING BY GRINNELL

WHENEVER PIPING IS INVOLVED

Meter Tester

IN ADDITION TO TESTING WATTHOUR meters, device can be used for checking accuracy of rotating standards by primary-standard method. Unit features electric circuit which requires no adjustment and remains unaffected by normal room lighting or by stray light falling on the phototube. Electric eye makes testing automatic. Concentrated light beam is focused on the watthour meter disk under test. Twice each revolution, the light shines through the anti-creep holes in the disk to the phototube beneath. This causes impulses to be transmitted to the control box, where they are amplified to control tester operation. By selector switches and relays, potential circuit of the rotating standard is closed and opened in accordance with the predetermined revolutions of the watthour meter. *General Electric Co, Schenectady, N. Y.*

Industrial Light

BECAUSE OF ITS ELLIPTICAL SHAPE, the fixture provides a wide lateral distribution of light. With proper spacing of fixtures, a brilliant barrier of light is created around property lines without illuminating buildings and grounds. Elipso Standlite is available in two styles, direct style which delivers light laterally, and angle style which provides a slight forward throw. Units are designed for mounting on standard 2-in. pipe. *Goodrich Electric Co, 4600 Belle Plaine Ave, Chicago, Ill.*

Meter Protector

FOR PREVENTING DAMAGE by lightning surge voltages, a new indoor watthour meter protector is announced. Known as Type A, the unit has a line to ground rating cutoff of 500 volts rms, a 60-cycle gap breakdown of 800 to 1200 volts rms, and a discharge capacity of 20,000 amps crest. Circuit voltage range is from 110 to 575 volts on 3-phase circuits. Consisting of an assembly of porous black elements and series gaps, the protector is inclosed in a round aluminum case filled with a non-inflammable compound. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

Seals

STOFFEL SEALS CONSIST of two components: The preshaped metal seal-cup and the individualized identification disk, multi-color printed. The seal can be permanently applied with either string, thin cord, or 2-ply wire, whichever is suitable to the sealing operation. Once these two component parts are

Glamour Girl of the Power House helps win the war

THE WAY they had been pampering Boiler No. 3, you'd think she were a glamour girl . . .

For years she had just been a stand-by boiler, pinch-hitting when needed. But now with the nation at war, she is back on the power line again, doing a day-in and day-out job.

And with the Allis-Chalmers Feedwater Service making sure that she is kept in shape at all times, Boiler No. 3 is doing a good job of it, an important job.

In your plant, too, you may have older equipment you are putting back into service . . . equipment that demands better-than-average care with its feedwater. Or you may have a completely modern plant and don't want to risk loss of efficiency or plant outages. In either case, Allis-Chalmers Feedwater Service will give you that better-than-average protection.

Remember — Allis-Chalmers is one of America's biggest industrial organizations, with vast resources and over 60 years experience in the power plant engineering field. Each plant to us is a specific case and is solved *in-your-plant* by a trained feedwater engineer.

Use your FULL power capacity . . . and protect it with Allis-Chalmers Feedwater Service. Write — today — for details. A 1477

FIRST STEP — when you submit your feedwater problems to us — is for a trained Allis-Chalmers Feedwater Service Engineer to visit your plant . . . analyze your conditions . . . take samples for preliminary study.

SAMPLES ARE then analyzed in the Allis-Chalmers laboratories . . . specific treatments suggested to prevent scale, corrosion, carryover, embrittlement, and all other feedwater ills, with provisions for changing conditions.

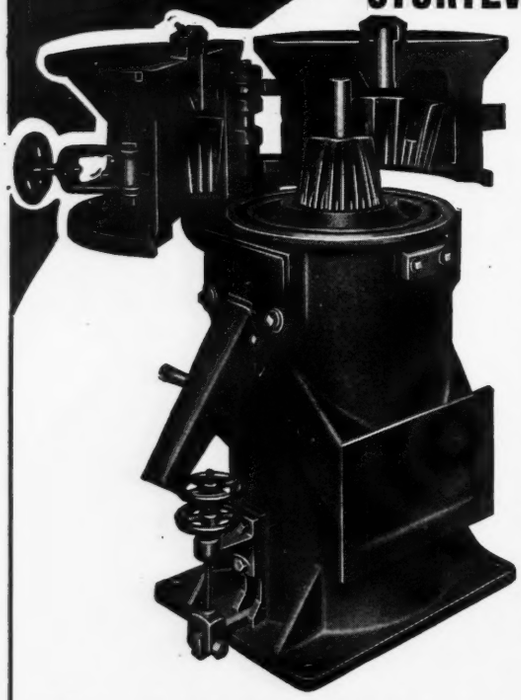
VITAL TO SUCCESS of service — the Field Service Engineer in your territory makes frequent calls . . . inspects equipment . . . makes repeated water and steam tests . . . gives you complete feedwater protection at all times.

ALLIS-CHALMERS

MILWAUKEE · WISCONSIN

What are you doing to keep coal costs down while steam demands go up?
Have you tried buying B.T.U.'s figured from testing coal *with the...*

Improved
STURTEVANT AUTOMATIC COAL CRUSHER and SAMPLER



Now is the time to take advantage of the surplus mine and transportation capacity to stock up on coal to the limit of your storage capacity.

But in following this sound advice, be sure that the coal you buy will not impair your boiler performance at a time when increased boiler capacity is essential to the power needs of war production.

Now is the time as never before to sample the coal you stock the "STURTEVANT WAY"—and know that you'll be properly protected in B. T. U. content and cleanliness against inefficient boiler operation and draft loss due to inferior, dirty coal.

The job of storing your coal, now, while it is still available, means that hand sampling is too slow and inaccurate a procedure to follow. Samples must be taken quickly and accurately. And that is where the fast accurate IMPROVED STURTEVANT AUTOMATIC COAL CRUSHER and SAMPLER fits right into the needs of the present emergency.

FOR EXAMPLE: The "STURTEVANT WAY" eliminates 32 of the 34 operations ordinarily required by hit-or-miss, laborious, inefficient hand sampling. Coal or coke fed into the machine is crushed between fine toothed crushing disc and stationary liner and thoroughly mixed to a truly representative correctly proportioned mixture.

This finely crushed material (approximately 8 mesh and finer) is uniformly discharged in 5, 10 or 15% samples as desired through "sample" spout thoroughly and automatically prepared for test. The possibility of human error is completely eliminated. Samples of coal prepared by the "STURTEVANT" method can therefore be depended on as being truly representative.

This improved machine, requiring only 3 hp. is sturdy, long-lived, compact and convenient and provides the means for instant sampling.

Stock Coal Now . . . but Sample it before You Burn it . . . Write today for Bulletin 85

Sturtevant Mill Co.
103 Clayton St., Dorchester, Boston, Mass.

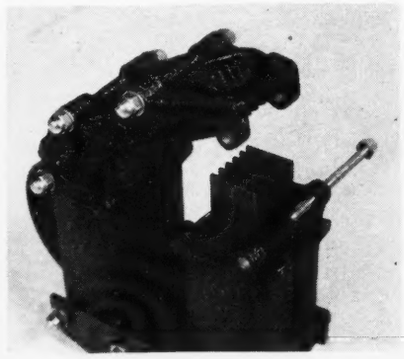
locked, the seal cannot be tampered without visual detection. Can be used for keeping fire extinguishers safe from interference after inspection, or for sealing drums and containers, and many other sealing and protecting applications. *Stoffel Seals Co, Inc, 188 Water St, New York City.*

Filter

FRANTZ FERROFILTER, designated as PQ-6, has been enlarged. New model has a 200-gpm capacity with a 3-in. pipe connection. Unit has no moving parts. *S G Frantz Co, 161 Grand St, New York, N. Y.*

Current Transformer

SPLIT-CORE CURRENT TRANSFORMER now available for testing power circuits. In many instances, it is difficult or impractical to open power circuits in order to conduct tests. Split-type transformer eliminates any necessity of opening circuit in question, whether or not it is carrying a load. It is only necessary to connect instrument to the transformer secondary terminal and close the separable core around the circuit cable or bus to effect a reading. Important feature of



split-core unit is that accuracy is practically independent of the tightness of closing of magnetic core. Illustration, showing right-angle interleaved core construction, helps to explain why the separable core may be left open as much as ¼ in. from "closed" position, without appreciably affecting instrument reading. This feature is said to permit metering of both watt and ammeter loads at sufficiently high accuracy for all general testing. Transformers are compensated for a 10-volt ampere instrument burden. Secondary windings and interconnecting leads are insulated and completely protected from mechanical injury. Windings are tested at 2500 volts to ground for one minute. This insures ample protection when working on 110, 220, or 440-volt power circuits. The transformers may be used on circuits of any voltage, provided the conductor is properly

2 TO 4 TIMES LONGER OIL LIFE

ON REDUCTION GEAR AND TURBINE

● SAVINGS in oil costs—just count them as incidental, if you wish. But think of the production time you'd save if your reduction gears and oil circulating systems could be operated two to four times as long before they needed cleaning.

A North Dakota power company found that it saved both time and money on the turbine and reduction gear pictured here. With a conventional turbine oil, sludge formed in the units every three to six months. Then, a fill of Stanoil was tried. It ran a full year before it was replaced. Even then, no deposits had formed and the oil was in good condition.

Discuss some of your maintenance problems with a Standard Lubrication Engineer. See if he hasn't a number of suggestions about lubrication that will help you cut down lost machine time. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Illinois.

Copr. 1942, Standard Oil Company (Indiana)

STANOIL

1. High Viscosity Index. *2.* Low Pour Point. *3.* Unusually High Stability. *4.* Excellent Demulsibility. *5.* Low Carbon-Forming Tendencies.

STANDARD OIL COMPANY (INDIANA)

LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION EN

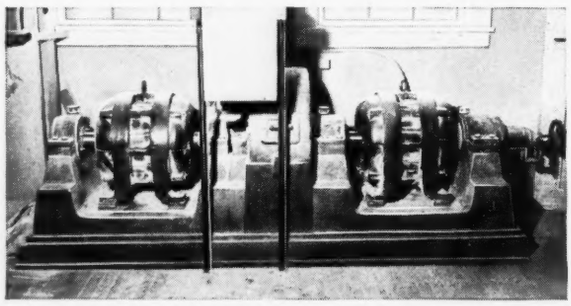
NG•••LUBRICATION ENGINEERING•••LUBRICATION ENGINEERING•••LUBRICATION ENGINEERING•••LUBRICAT

CUTS DOWN BEARING REPLACEMENTS WITH . . .

SUPERLA GREASE

Frequent requests for replacement bearings from certain customers were worrying the manufacturer of an attrition mill. Why did some have this bearing trouble while others were getting excellent bearing life?

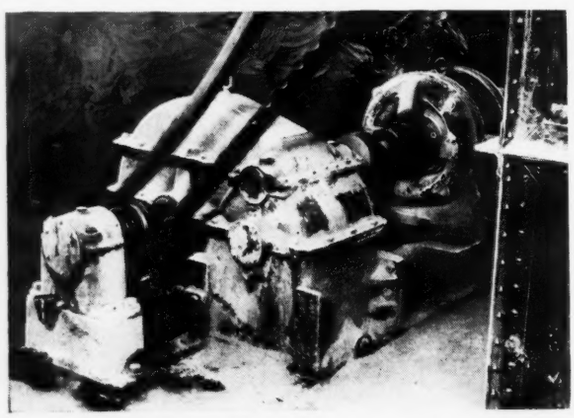
A brief survey in the field soon uncovered the reason—poor lubrication. He decided that his job wasn't finished when he built a well designed, efficient mill. Exhaustive tests were made of various greases, including Superla Grease—a Standard Oil Engineer's recommendation. Because of the unusual results obtained, a 10-pound package of Superla is now shipped with every machine. Bearing complaints are practically eliminated where the manufacturer's lubricating instructions are followed.

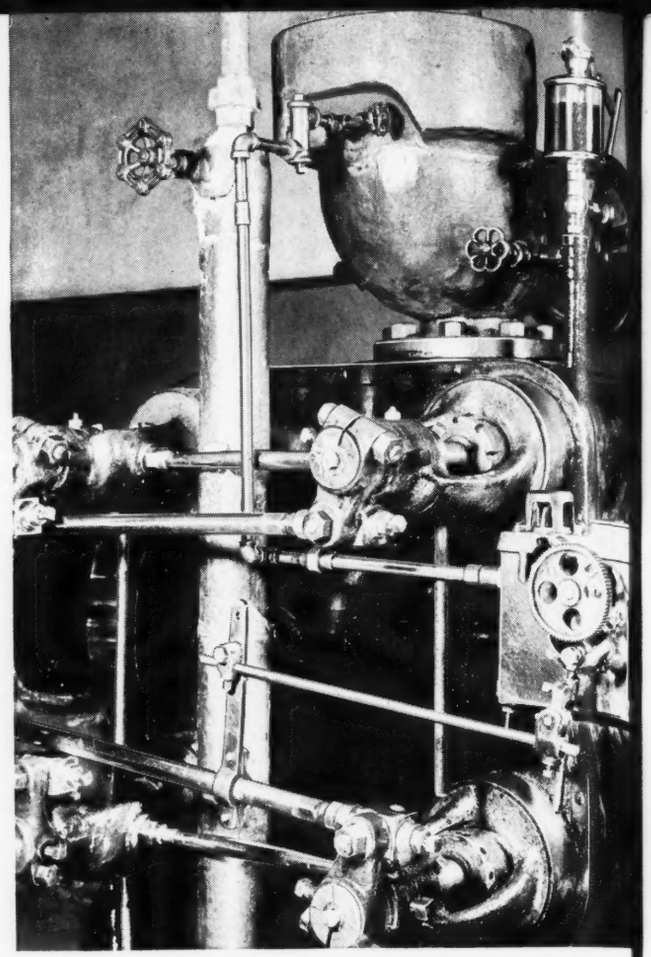


Whether you manufacture or operate grease lubricated equipment, a Standard Lubrication Engineer will be glad to show you how Superla can help you avoid bearing trouble.

STANOIL KEEPS GEAR CASES CLEAN ON SPEED REDUCERS

Is 24-hour operation increasing the maintenance of your power transmission equipment? For example, do speed reducers require more frequent oil changes? Are deposits building up faster in the gear cases? See if you can avoid the increased labor and lost machine time they'll cause. Test a fill of Stanoil in one of your speed reducers. Watch how long it stays clean and free from any sign of asphaltic deposits or sludge—usually two or three times as long as a conventional engine oil. This higher quality lubricant not only gives trouble-free operation, but it frequently reduces lubricant costs at the same time.





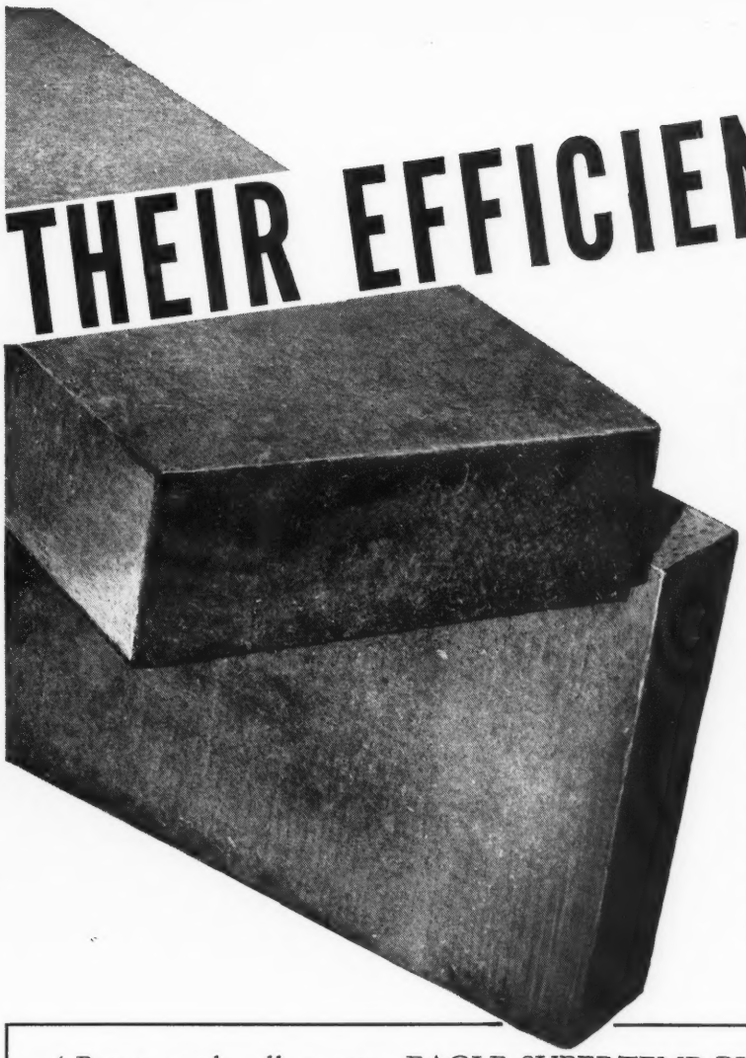
STANDARD STEAM CYLINDER OILS WILL HELP YOU MEET HEAVIER POWER DEMANDS

Higher steam pressures, maximum loads, or longer hours of operation—you have probably tried all known ways to meet the demands put on your power generating equipment. But, have you taken steps to prevent these emergency changes from eventually causing serious delays? Are you sure that the lubricants you are using will meet the new operating conditions? Will the cylinder oil give the necessary protection against increased wear? Let a Standard Lubrication Engineer answer these questions for you. He is working with other power plant men on these same problems. You can have the benefit of this experience at no cost to you. You may save many hours of maintenance time by spending part of an hour with one of these Engineers now.

SAVE TIME ON LUBRICATION PROBLEMS . . . ASK A STANDARD OIL ENGINEER FIRST

At the first sign of lubricating trouble, call in a Standard Lubrication Engineer. You'll save time by not having to experiment with various lubricants. You'll save maintenance by getting the answer to your problem sooner. You may even avoid that first sign of trouble if you call in one of these Engineers now and discuss your plant lubrication with him. Write the nearest Standard Oil Company (Indiana) office, or 910 S. Michigan Avenue, Chicago, Illinois. Ask for the Lubrication Engineer. In Nebraska, write the Standard Oil Company of Nebraska at Omaha.

THEIR EFFICIENCY LASTS!



Eagle Supertemp Blocks are made of mineral wool . . . Reports show full efficiency for temperatures to 1700° F.

Economy-minded power plants have needed an insulation like this for years!

Eagle Supertemp Blocks are efficient for a full range of temperatures. They're fabricated of Eagle Mineral Wool — a lightweight material with the "dead air cell structure" so essential to high effectiveness — a material that is both chemically and physically stable.

Actual experience on hundreds of installations proves that Eagle Supertemp Blocks are readily installed — and in addition to their very low thermal conductivity are strong and tough enough to withstand all normal handling and usage. Their lasting efficiency assures remarkable fuel savings for temperatures as high as 1700° F.

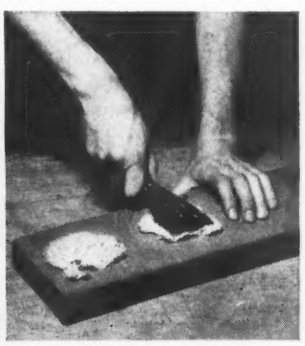
Write today for free catalog sheets.

4. Reasons why all-purpose EAGLE SUPERTEMP BLOCKS are cutting insulating costs . . .

1. ***They cut like cheese.*** A sharp knife or saw quickly slices Eagle Supertemp Blocks. They're easily cut on the job to fit all ordinary or odd-shaped surfaces.

2. ***Sufficiently flexible.*** Pencil test demonstrates how Eagle Supertemp Blocks conform to ordinary curved surfaces. Have great breaking strength.

3. ***Snug fit.*** The underneath side of Eagle Supertemp Blocks is compressible. It's easy to fit blocks over projecting rivet heads and other surface irregularities.



4. ***Easily installed.*** Eagle Insulstic speeds application of Eagle Supertemp Blocks. This fibrous plastic binds blocks until permanent support is completed.

Eagle-Picher High Temperature Insulations

Eagle Super "66" Plastic Insulation
Eagle Supertemp Blocks
Eagle L-T Felts
Eagle Blankets

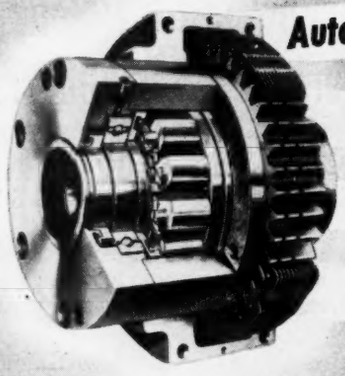
EAGLE EP PICHER

Eagle Finishing Cements
Eagle Loose Wool
Eagle Insulseal
Eagle Insul-stic

THE EAGLE-PICHER LEAD COMPANY · CINCINNATI, OHIO

INCREASE DUAL DRIVE EFFICIENCY
AND REDUCE MAINTENANCE with...

MORSE FREE WHEELING CLUTCH COUPLINGS



Automatic Dual Drive Operation!

Maintain Constant Speeds!

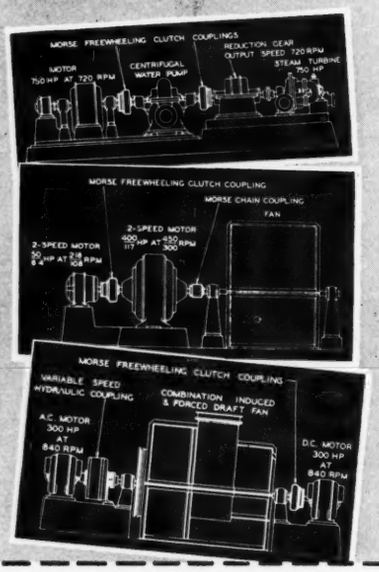
Meet ALL Load Demands!

Reduce Power Waste!

Morse Free-Wheeling Clutch Couplings automatically perform functions of manually operated clutches with far greater efficiency. No time out for shifting levers or cut-out mechanism is required. Regardless of varying speeds and loads, operation of any dual drive equipped with Morse Free-Wheeling Clutch Couplings is constant and highly efficient.

Morse Free-Wheeling Clutch Couplings automatically engage when torque is applied and disengage when torque ceases. They permit power units to drive the load independently or simultaneously. Switching load from one power unit to another is accomplished automatically without stopping or retarding speed of load. Maintenance cost is lower, too, because when one power unit is not required it cannot be rotated by the other—eliminating damage to turbine rotors or motor windings of idle power units.

A MORSE CLUTCH FOR EVERY DUAL DRIVE



SEND FOR NEW ENGINEERING DATA

New Morse Clutch Bulletin K-6 gives diagramed and charted engineering data, including power-speed ratios, load capacities, dimensions and prices.

MORSE CHAIN COMPANY, 7601 Central Avenue
Detroit, Michigan

Please send me new Morse Free-Wheeling Clutch Bulletin K-6.

Name_____

Company_____

Address_____

(P-M-42)

MORSE FREE-WHEELING CLUTCH COUPLINGS

Morse Chain Co., Detroit, Mich. • Ithaca, N. Y. • Div. Borg-Warner Corp.

insulated before placing the transformer in position. Orders for these units must carry priority rating. *R B Annis Co, 1101 N Delaware St, Indianapolis, Ind.*

Mercury Relay

H-B MERCURY PLUNGER RELAY has been completely redesigned and improved to insure long life, even under severe conditions of vibration and shock, according to manufacturer. Maker also states that three important gains resulted from design change. These are (1) the metal cap and support frame that held mercury tube were eliminated, releasing strategic metals, (2) mercury tube was made secure by a single metal band, said to give twice the stability of previous design, and, (3) the area for terminal fastening and connecting was tripled, eliminating danger of tube breakage and simplifying installation. Rated at 30 amp, 110 volts, 1 hp, available for either ac or dc. *H-B Electric Co, 2530 N Broad St, Philadelphia, Pa.*

Builders' Plastic

WET-X-HALE BUILDERS' PLASTIC is an oil base portland cement product, combined with various indestructible fine aggregates, so ratioed and processed as to become a smooth working plastic medium, producing a firm and tough, yet flexible finish. Can be applied to steel, wood, masonry, fiberboard and new galvanized steel without neutralizing zinc plating. No metal or wood last is required, and plastic becomes harder with age, still retaining flexibility. Said to be unaffected or penetrated by moisture, rain, salt-water spray, hot sunrays, freezing, etc. Plastic is suitable for duplicating all finishes of ordinary cement plaster. *The Rogear Co, 11 Water St, New York.*

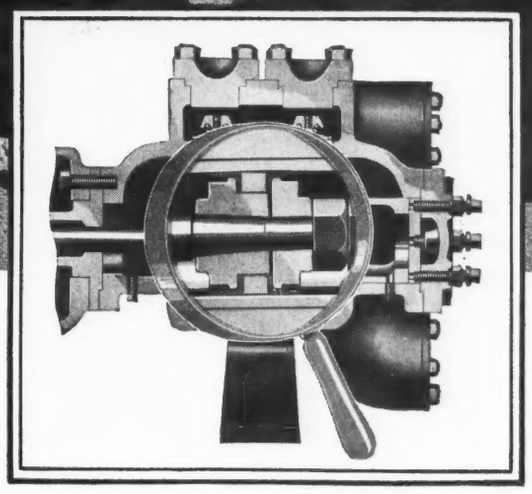
Low-Temperature Fluorescent Lamp

HYGRADE FLUORESCENT LAMP is designed for low-temperature operation. Because standard fluorescent lamps do not operate efficiently at temperatures lower than 50 F, these lamps will fill a definite, though limited need. Hygrade LT lamp is designed to start and operate satisfactorily at temperatures as low as zero F when used in conjunction with the company's Mirastat No. 4. Because of limited application, lamp will be supplied only in 40 watts, white. *Hygrade Sylvania Corp, Salem, Mass.*

Tubing

FIBRONIZED KOROSEAL TUBING designed for use as electrical insulation by manu-

SAVINGS UP TO $100.00 per Pump per Year Made with DARCOVA PUMCUPS!



● Don't wait — start now to cut your reciprocating pump costs by installing Darcova Pumcups. Your pumps, new or old, regardless of present packing will operate with more efficiency, once this money-saving installation is made.

Time tested over a period of *35* years in the most severe pumping operations, this truly remarkable composition product has successfully performed under the hardest and most grueling services. Darcova Pumcups offer advantages — *many* advantages that no other type of packing can give. Try Darcova Pumcups — keep track of the costs and judge for yourself.

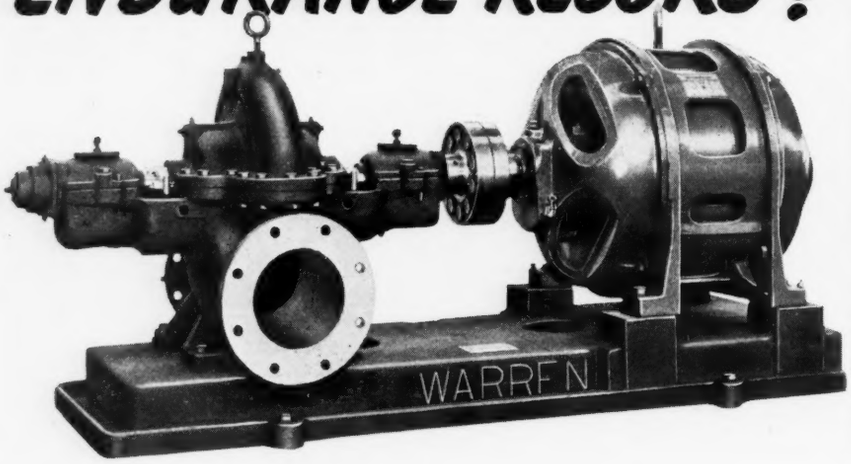
TAKE ADVANTAGE OF THE FREE *DARCOVA* SURVEY SERVICE

Darcova field men can help you just as they are helping others, to get the most for your pumping dollar. Call them — or ask any Supply Store — or write direct.

DARCOVA
TRADE MARK
THE ORIGINAL COMPOSITION CUP

DARLING VALVE & MANUFACTURING CO.
WILLIAMSPORT, PA.

SETTING ANOTHER WARREN ENDURANCE RECORD?



Keep everlastingly at it—seems to be the motto of Warren Pumps. A typical example of Warren stick-to-it-iveness is illustrated by a Warren Pump which *so far* has been in service for over 6 years, 24 hours a day, 6 days a week . . . without letting down or having to be opened up.

What *one* Warren Pump offers in gameness is matched by every other Warren Pump, no matter what type or size. *All* Warren Pumps are constructed on the same sound engineering principles . . . made from the finest materials, reliably and economically.

To obtain this long-time performance call in a Warren Engineer — and leave the rest to the Warren Pump.

WARREN PUMPS

WARREN STEAM PUMP COMPANY
Incorporated
WARREN, MASSACHUSETTS

facturers in the electronic, instruments, aircraft, electrical appliances and power industries. Insulation was developed by the company's Fibron Division from Koroseal, a product of the B F Goodrich Co. Advantages include inside and outside smoothness, exceptional elasticity, and close manufacturing tolerances. Has resistance to acids, alkalis, solvents and heat. Tubing meets or excels all ASTM specifications, and comes in ASTM sizes and in a variety of colors. *Irvington Varnish & Insulator Co, Newark, N. J.*

Lamp Starter

NEW LINE OF FLUORESCENT LAMP STARTERS is designed to protect ballast and starter, and to eliminate flashing of failed lamps. Automatically opening the circuit when a lamp fails, Premium Mirastat units are especially suitable for installations that make immediate replacement of a burned-out lamp impractical. The unit not only protects itself, but prevents abuse of the ballast and effects a substantial saving of power, but also does away with the usual annoying flashing of a burned-out lamp. *Hygrade Sylvania Corp, Salem, Mass.*

Electric Unit Heater

ELECTRIC UNIT HEATERS are available in 5- and 7½-kw sizes, 230 volts, 50 and 60 cycles, with an output of 17,060 and 25,590 Btu, respectively. These are an extension of 2, 3 and 4-kw heaters announced previously. Heater is cylindrical with bracket designed for vertical adjustment. Unit is powered by a ⅛-hp motor with resilient mounting, 4-blade fan operating at 1725 rpm to produce 615 cfm at a velocity of 785 fpm. A Coroz heating elmeent is used, with a temperature limit switch connected to the control circuit of the contactor to prevent overheating. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

Socket and Tool Set

74-PIECE SOCKET AND TOOL SET, known as No. BB1, has every piece selected because of its general utility value in service work of all kinds. Included in the set is an assortment of 14 sockets with double hexagon openings from $\frac{7}{16}$ to 1 in.; three extra-deep sockets with double hexagon opening from $\frac{13}{16}$ to 1 in. Two sockets with ½ in. and $\frac{5}{16}$ double square openings, plus wrenches, universal joints, hinge handles, reversible ratchet, etc. *Bonney Forge & Tool Works, Allentown, Pa.*

MULTIPLE V-BELT DRIVE ASS'N

THE DOMINANT DRIVE OF INDUSTRY

TRADE MARK

The use of this emblem by an association member in connection with Multiple V-Belt Drives is your assurance of mechanical excellence — the result of cooperative engineering, research and experience.

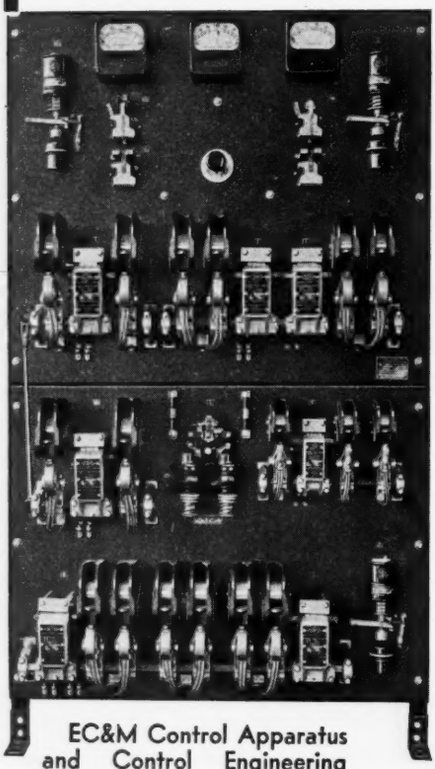
team work at its best — in multiple v-belt drives

The fundamental principle of the Multiple V-Belt Drive, which made it "The Dominant Drive of Industry", is the even distribution of power through each driving unit. . . . This principle, known technically as "automatic equalization of the load", is the closely coordinated, balanced teamwork of every belt in the drive, resulting in even pull, even speed, and a smooth, quiet flow of power. . . . In the early development stages, the automatic equalization of the load was proved and demonstrated by intensive and unceasing laboratory research, field tests, and data comparisons by the engineering staffs of association members. . . . The precision standards for all component parts of the Multiple V-Belt Drives, adopted as a result of these findings, are an exemplary contribution to economy and uniformity of production wherever machinery is used.

MULTIPLE-V-BELT DRIVE ASSOCIATION
140 SOUTH DEARBORN STREET • CHICAGO

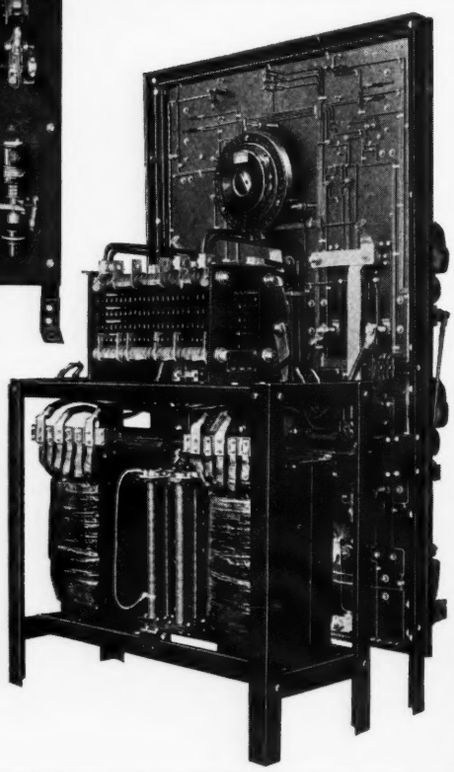
...THEY COULDN'T AFFORD A SHUTDOWN

M-G Set Brought Up To Speed Safely —and Without Tripping Breaker



Customer's power service was loaded to capacity. A Standard Motor Starter was tried out but it frequently failed to bring the motor up to speed without causing the main power breaker to trip and shut the whole plant down.

An EC&M representative was called in. The starter recommended by EC&M performed successfully from the beginning and has not caused a single shutdown.



EC&M Control Apparatus and Control Engineering rank at the top for the solution of difficult control problems. This EC&M Combination Auto-transformer and Primary-resistor Starter for reduced voltage starting of 400 HP, 440 Volt Synchronous Motor-Generator Set is only one of many illustrated and described in our 24-page Booklet No. 88 on Custom Built Motor Control. Mail the coupon today for your copy.

THE ELECTRIC CONTROLLER & MFG. CO. CLEVELAND, OHIO

HEAVY DUTY MOTOR CONTROL FOR CRANES, MILL DRIVES AND MACHINERY • BRAKES • LIMIT STOPS • LIFTING MAGNETS AND AUTOMATIC WELD TIMERS.

THE ELECTRIC CONTROLLER & MFG. CO.
2711 E. 79th St., CLEVELAND, OHIO

Gentlemen:
Please send me a copy of illustrated Booklet No. 88 describing EC&M 110 to 550 volt Motor Starters.

Name.....

Company.....

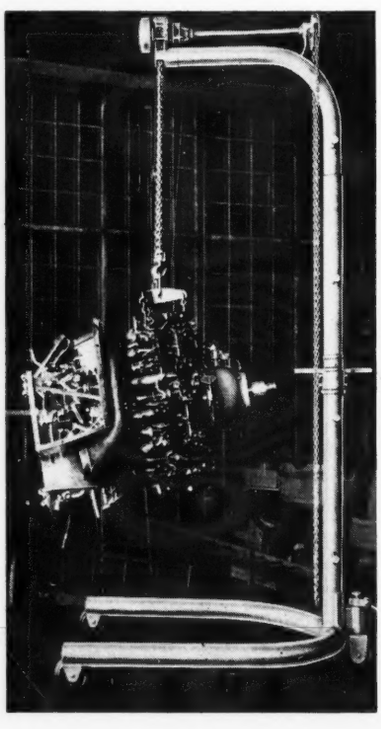
Address.....

Balancing Unit

PORTABLE DYNAMIC BALANCING UNIT is designed to reduce harmful vibration and undesirable noise in rotating machines assembled by mass production methods. Known as Type HQ, balancing unit consists of a sensitive wattmeter assembly, a sine wave generator, a velocity vibration pickup, and necessary cords. The apparatus may be used over a speed range of from 600 to 10,000 rpm, and by an auxiliary attachment the range may be extended down to 100 rpm. The pickup produces a voltage whose amplitude is proportional to the vibration being measured, and has a fixed phase angle relationship with the vibration for a fixed frequency. Sine wave generator produces an adjustable phase sine wave current-supply whose frequency coincides with the rpm of the machine being balanced. Its field is a 2-pole rotating magnet directly coupled to the machine rotor. The stator has two windings 90 deg apart electrically that facilitate angle and amount observation. Metering unit consists of a specially designed double scale, highly damped dynamometer type wattmeter, calibrated in arbitrary units. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

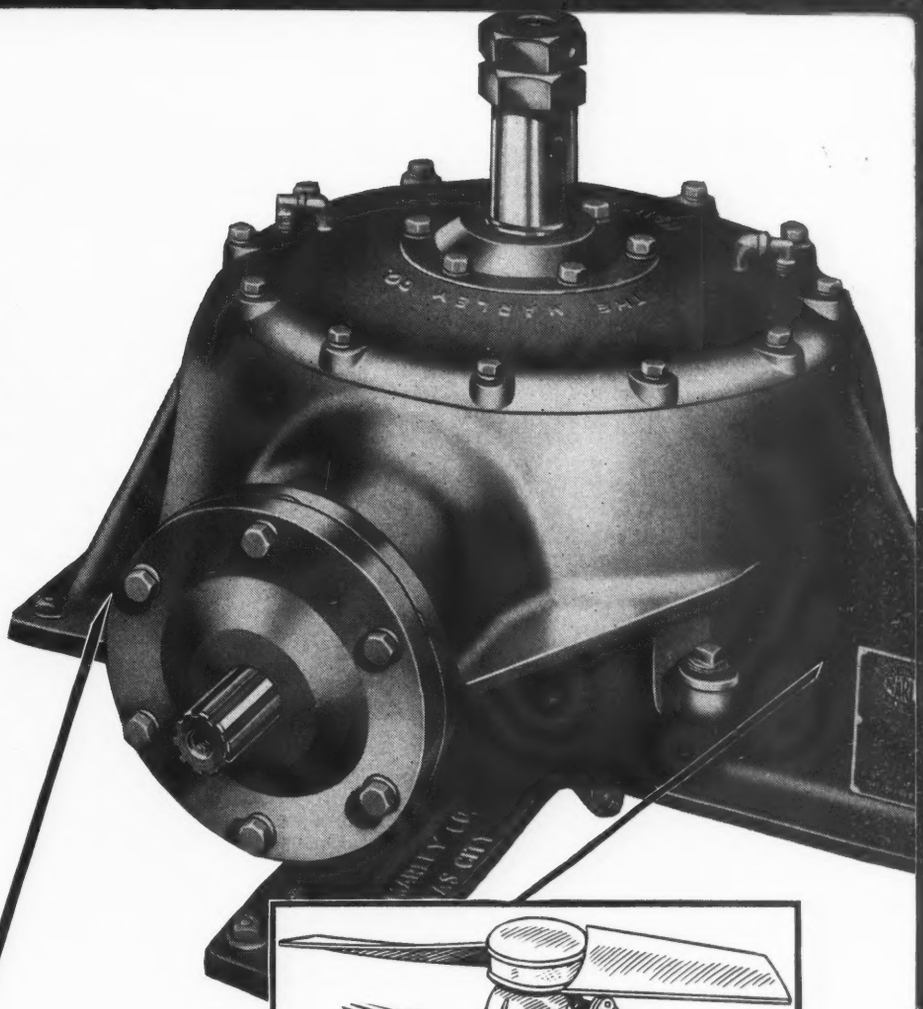
Portable Hoist

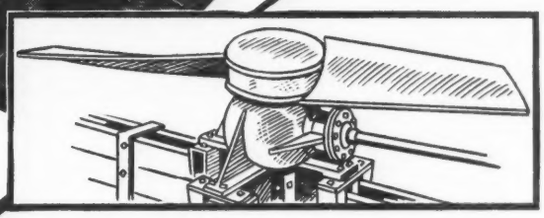
PORTABLE HOIST, originally designed for the aviation industry, has found numerous applications in general manufacturing operations. Has a single upright mast equipped with riser steps and adjustable platform. Chain hoist raises

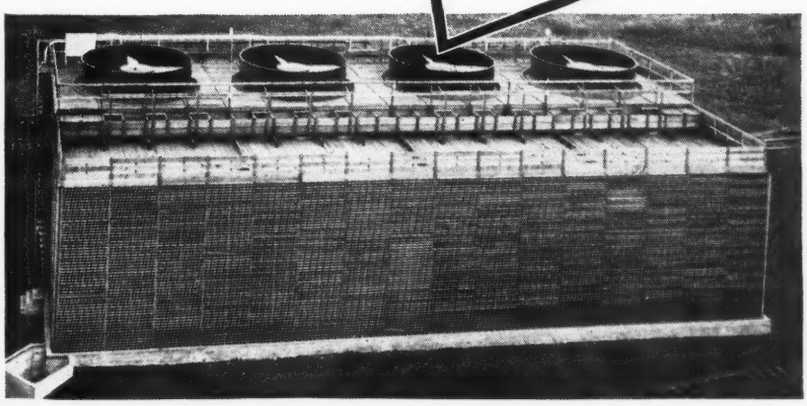


One of a series of advertisements, each devoted to a Marley cooling tower feature that has become an accepted standard of the best practice in modern mechanical draft water cooling.

Another of MARLEY'S PLUS Features







The *only* speed reducer designed specifically for cooling tower service, the Marley GEAREDUCER is produced solely by its originators, The Marley Company, to provide:

1. **Positive, direct drive for cooling tower fans from motors *outside* the air stream.**
2. **Unfailing operation in continuous service, without halt day and night, month after month.**
3. **Rugged dependability under punishing conditions of heat, dampness and heavy duty demands.**

The hundreds of GEAREDUCERS in service, many continuously throughout most of the past decade, are evidence of their success and acceptance. Positive lubrication, gears of "upset" forged moly-chrome steel, Timken tapered roller bearings, and rugged cast iron cases are but a few of their noteworthy features. Yet the GEAREDUCER is just one of many outstanding mechanical and structural details exclusive with Marley which, together, are the reason so many more cooling towers bear the Marley name than any other.

42A

MARLEY COOLING TOWERS

Every MARLEY TOWER *is individually engineered by* THE MARLEY CO., INC. — KANSAS CITY, KANSAS

WELDOLETS· THREDOLETS

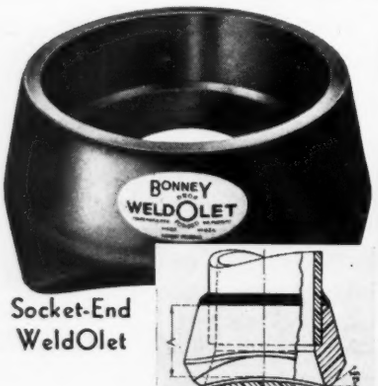
TRADE MARKS - REG. U. S. PAT. OFF.

. . . Welded Outlets for Piping . . .

For Making Right-Angle Welded Branch Pipe Outlets of Full Pipe Strength

WeldOlet

ThredOlet



Socket-End WeldOlet

BONNEY WeldOlets, ThredOlets and Socket-End WeldOlets are designed for making leakproof, right-angle branch pipe outlets of full pipe strength. Tees, crosses, side outlets, side outlets and crosses and double crosses . . . . any one or all can be made with these fittings.

The heavy, external rib and the wide bases or footings compensate for loss of strength in the main pipe when the button is removed and eliminate the need for extra braces or supports to take care of the vibrational stresses set up at these junctions.

Because they provide wide, funnel-shaped outlets, WeldOlets, ThredOlets and Socket-End WeldOlets improve flow conditions and reduce turbulence and friction to a minimum.

No templets are needed. The hole in the main pipe, in most cases, is cut after the fitting is installed. They eliminate all threading and fitting of the main line and simplify alignment of the main and branch pipes.

Standard, stock fittings (outlets from 1/4" to 12") in size-to-size and reducing sizes are of drop forged steel. On special order they can be furnished in sizes up to 24"x24". For special applications or where unusual conditions exist, they can be supplied in Toncan Iron, wrought iron, brass, Monel, Everdur, etc. WeldOlets, ThredOlets and Socket-End WeldOlets are suitable for every type of piping installation and for all commonly used pressures and temperatures.

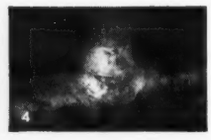
Your local distributor will be glad to tell you the complete story about savings which can be effected, or write for BULLETIN WT29—TODAY.

EASILY INSTALLED

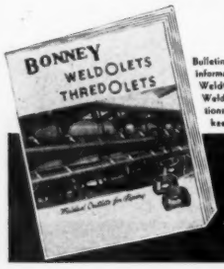
Mark center lines and tack the fitting into place.

Then weld the fitting to the main pipe.

Remove the button, which will also permit inspection of the inside of joint.



Then attach the branch pipe.



Bulletin WT-29—20 pages packed with information and data on advantages of WeldOlets, ThredOlets and Socket-End WeldOlets in all types of piping installations. Write for your copy NOW and keep it in your files.

BONNEY FORGE & TOOL WORKS

FORGED FITTINGS DIVISION

ALLENTOWN, PA.

and lowers the work, or supports it at any desired height, and an extension keeps hand chain safely away from the load. Brake locks the hoist in position. Available in one- and two-ton models. *Aviation Dept, Whiting Corp, Harvey, Ill.*

New Power Construction

Construction to come

Arizona, California, Nevada—Bids Mar 2, by Bureau Reclamation, Customhouse, Denver, Colo., for four transformers, five disconnecting switches, three station lightning arresters, metering equip for Nevada State switchyard and Boulder City substation, Boulder Canyon Project, Spec. 1026.

Ark., Lewisville—Arkansas Louisiana Gas Co, 300 W Capitol St, Little Rock, plans constructing desulphurization plant. $3,500,000.

Calif., San Francisco—City and San Francisco Co, plans constructing steam pump. plant, Lake Merced, $1,250,000.

Colo., Colorado Springs—Bids Mar 7, by City, F W Wiley, supt, imprv power house, new boiler. Burns & McDonnell, 107 W Linwood Blvd, Kansas City, Mo., engrs.

Fla., Pensacola—Yards & Docks, Navy Dept, 18 St and Constitution Ave N W, Wash., D. C., allocated funds constructing additional aviation facilities, bldgs, accessories, Naval Air Station. $1,685,000.

Idaho—Dept Interior, Interior Bldg, 19 and C Sts N W, Wash., D. C., plans constructing power plant, Palisades. $11,900,000.

Idaho, Weiser—Bureau Reclamation, Denver, Colo., plans constructing Spangler Dam. $1,000,000.

Illinois—War Dept 20 St and Constitution Ave N W, Wash., D. C., plans constructing plants. $10,000,000.

Illinois—War Dept, 20 St and Constitution Ave N W, Wash., D. C., plans constructing plant. Industrial co will operate. Defense Plant Corp will finance. $20,000,000.

Illinois—War Dept, 20 St and Constitution Ave N W, Wash., D. C., plans construction plant. Defense Plant Corp will finance. $25,000,000.

Illinois—U. S. Eng, 816 U S Courthouse & Customhouse, St. Louis, Mo., plans construction plant. Remington Rand, Inc, 465 Washington St, Buffalo, N. Y., archt-engr and management services. Over $5,000,000.

Ill., Rochelle—City plans imprv power plant, etc. $90,000.

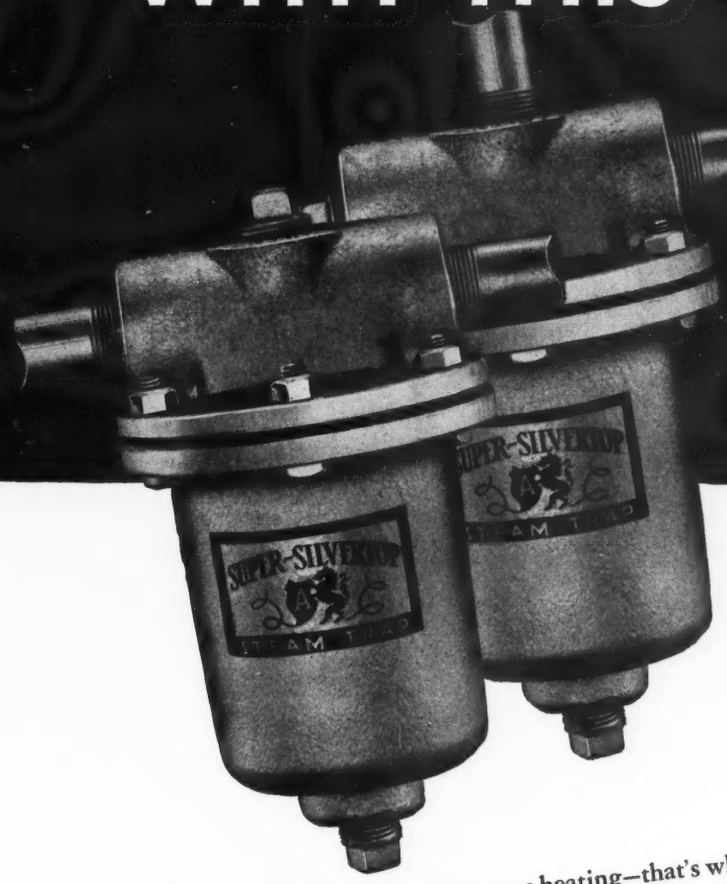
Ill., Chicago—Chrysler Corp, 341 Massachusetts Ave, Detroit, Mich., plans constructing plant for War Dept. $100,000,000.

Ill., Chicago—Crane Co, 836 S Michigan Ave, plans by Graham, Anderson, Probst & White, 80 E Jackson St, and bids soon constructing factory bldgs. $6,000,000.

Ill., Chicago—Crane Co, 836 S Michigan Ave, plans constructing plant for Navy Dept. $6,000,000.

Ind., Evansville—Bids Mar 17, by U S Eng, P O Box 59, Louisville, Ky., five pump. plants, altering pump. plant.

Speed Production WITH THIS 2-WAY STEAM TRAP



More production, more batches per day on process heating—that's what you get from systems drained by Anderson Super-Silvertop, the 2-way steam trap. This advanced design, inverted bucket trap keeps temperatures of steam equipment at a constant maximum that more nearly approaches theoretical steam temperatures. This is accomplished by keeping the units free of all entrained air and condensate.

Besides, Super-Silvertops save time in selection when you use the valuable book "How To Choose a Steam Trap." Its helpful charts and tables tell you almost instantly what size and style of trap is needed for each trapping problem.

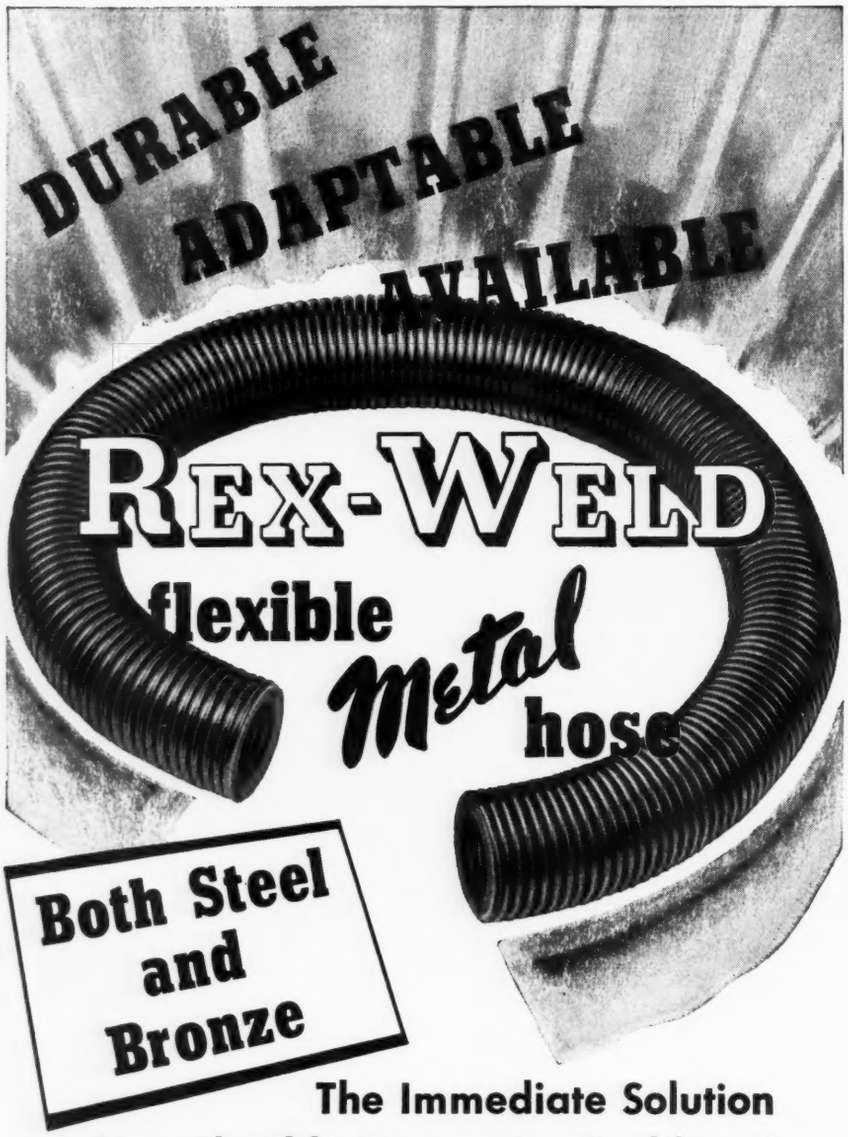
You save installation time (as much as 60 minutes per trap) with Super-Silvertop since there are only two threaded joints whether you install the trap as an elbow or straight-in-line. See illustration above.

Anderson Super-Silvertops also save on maintenance because of their long service life and trouble-free operation. Users report Super-Silvertop traps operating for five and ten years without replacement or repairs. You even save time on periodic inspections since trap stays on the line, inspection is made without disturbing pipe connections.

At least find out about this different steam trap—send today for your copy of "How To Choose a Steam Trap." It is handy and helpful even if you prefer some other trap.

THE V. D. ANDERSON COMPANY
1934 W. 96th Street • Cleveland, Ohio

Super-Silvertop
STEAM TRAPS



The Immediate Solution to Your Flexible Connection Problems!

Type RW-81
(annular corrugations)

Type RW-91
(helical corrugations)

REX-WELD* (corrugated) *Flexible METAL Hose

Sizes from ⅛" I. D. to 4" I. D. inc. Pressures to 14,500 p.s.i. Temperatures to 1000° F. One-piece, all-metal construction. Continuous lengths to 50 feet.

Rex-Tite Mechanical (Re-attachable) couplings; solder couplings; brazed and welded couplings and flange assemblies for Rex-Weld Flexible Metal Hose.

Complete Data on Request

CHICAGO METAL HOSE
CORPORATION
MAYWOOD, ILLINOIS

Iowa—U S Eng, 1709 Jackson St, Omaha, Nebr., plans by Buell & Winter Eng Co, 508 Ins Exch Bldg, and W Beuttler, 405 Ins Exch Bldg, both Sioux City, for new construction. To exceed $5,000,000.

Iowa—War Dept, 20 St and Constitution Ave N W, Wash., D. C., plans constructing plant. $30,000,000.

Kan., Coffeyville—City plans imprv power and light plant, switchboard, boilers. Black & Veatch, 4706 Bway, Kansas City, Mo. engrs. $40,000.

Kan., Kansas City—Bids Mar 4, by City, installing power piping, Contr 118, in connection with power plant addn. Burns & McDonnell, 107 W Linwood Blvd, Kansas City, Mo., engrs. $150,000.

Maryland— U S Eng, Standard Oil Bldg, Baltimore, plans new constrluction. Est under $5,000,000.

Michigan—Fairbanks, Morse & Co, Beloit, Wis., plans constructing factory exten. Federally financed. Over $1,000,000.

Mich., Saginaw—Wickes Bros, 512 N Water St, plans constructing boiler plant. $200,000.

Mich., St. Joseph—Auto Specialties Mfg Co, St. Joseph, plans by Giffels & Vallet, archts and engrs, 1000 Marquette Bldg, Detroit, construction steel-shell factory, 60x150 ft office bldg, steel transformer station. $1,000,000.

Minn., Red Wing—Northern States Power Co, 2 S Barstow St, Eau Claire, plans constructing power plant. $1,500,000.

Minn., Springfield—City, A C Mueller, city clk, plans purchasing, installing steam boiler, turbine. Over $40,000 (not official).

Miss., Hattiesburg—Mississippi Power Co, Bank Gulfport Bldg, Gulfport, plans constructing power plant.

Mont., Polson—J E Busey, L Helmer & L L Marsh, Polson, plans construction pulp and paper mill. L A DeGuerre, Wisconsin Rapids, Wis., engr. $2,000,000.

N. Y., New York—Dept Public Wks, Municipal Bldg, plans reconstructing electrical, mechanical power heating and ventilating equip of Museum Bldg, New York Botanical Garden, Bronx. Estimated $100,000.

Ohio, Cleveland—Giffels & Vallet, engr, 1000 Marquette Bldg, Detroit, Mich., receiving bids constructing factory, and 44x162 ft office bldg, for Nottingham Equipment Works, Div General Electric Co, 1 River Rd, Schenectady, N. Y. Defense Plant Corp will finance. $1,000,000.

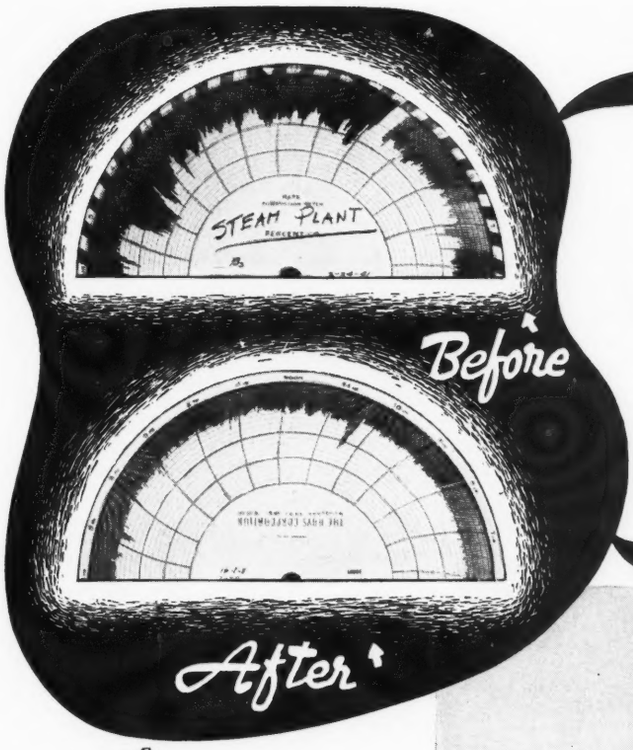
Ohio, Cleveland—White Motor Co, G F Dort, asst works mgr, E 78 St and St Clair Ave, plans constructing boiler plant imprvs new boilers, fdn. H Hinkleme, c/o owner, engr. $40,000.

Ohio, Painesville—Bd Comrs Lake Co, Painesville, plans constructing sewage disposal plant, near mouth Chagrin River with trunklines branching into northwest sect Willoughby Twp, Willoughby. P D Cook, Painesville, sanitary engrs. $1,000,000.

Oregon and Washington—Bids Mar 17, by Bonneville Power Admin, P O Box 3537, Portland, Ore., oil circuit breakers for substations, Portland, Ore., Longview, Spokane, Covington and Ampere, Wash.

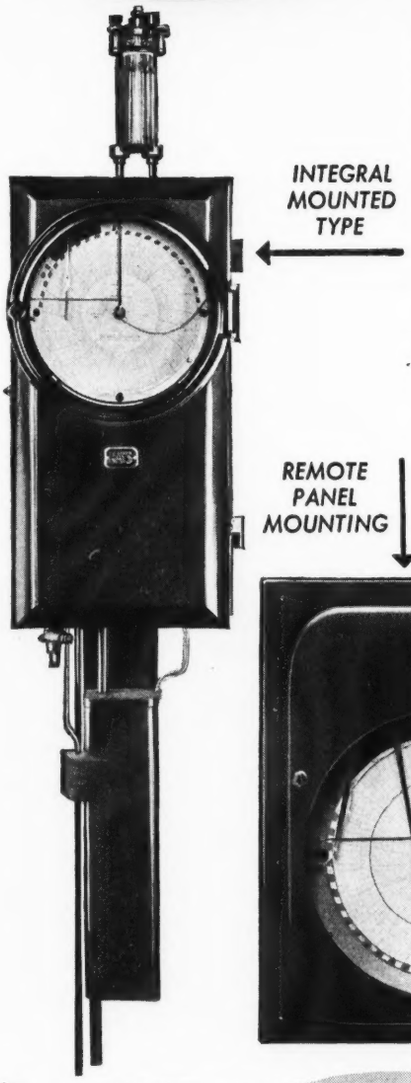
Tenn., Memphis—Bids Mar 16, by U S Eng, P O Box 97, West Memphis, Ark., constructing hospital steam plant and hospital, Park Ave and Shotwell St, Hobbs-Howe & Reese, Amer Trust Bldg, Nashville, archts and engrs.

Texas—War Dept, 20 St and Constitution Ave N W, Wash., D. C., plans constructing two plants. $50,000,000 each.



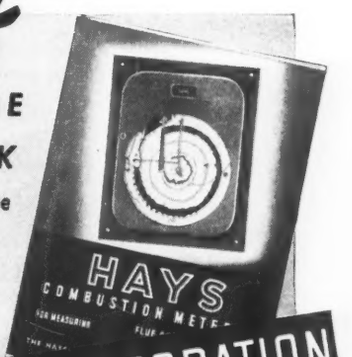
HOW HAYS COMBUSTION METER *Improves Boiler Operation*

THE two segments of charts shown above, taken from a Hays Combustion Meter installed in a north west paper mill tell a graphic and convincing story. Upper chart shows the low and erratic CO_2 the first day of operation, typical of the wasteful method of firing before installation of meter. Lower chart shows results exactly one week later, after the meter had taught the operators how to fire the boiler properly — fuel saved, smoke eliminated, more heat secured, steam pressure more constant.



Send FOR THIS HANDSOME NEW BOOK

It contains complete information on CO_2 —its significance and measurement. It's FREE.



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SINCE 1903
COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.

Supervised Boiler and Condenser Cooling System Protection at Moderate Cost!

We believe the true answer to your boiler water and condenser cooling system problem lies in competent supervision of water conditions by experts plus a simplified natural method of water correction.

Our new Technical System does just that! Scheduled supervision and treatment based on frequent water analysis finds and remedies your trouble . . . specific organic formulas developed individually to fit your needs provide a simplified, natural correction. Send the coupon below for the new Technical System bulletin or have a Water Treatment Company engineer inspect your plant without obligation.

☐ Please send the new Technical System bulletin.
☐ Have a Water Treatment Company engineer call.

Name ..... Title .....

Company .....

Address .....

WATER TREATMENT COMPANY of America
1159 HODGKISS STREET • PITTSBURGH, PA.

Texas, Texas City—Carbide & Carbon Chemicals Corp, subsidiary Union Carbide & Carbon Corp, 30 E 42 St, New York, N. Y., plans addnl plant expansion. Ford, Bacon & Davis, Inc, 39 Bway, New York N. Y., engrs.

Utah—Bids after April 1, by industrial company constructing steel plant. Defense Plant Corp will finance. $126,000,000.

Washington—Industrial company plans constructing improvements. $5,000,000.

Washington, Idaho and Oregon—Bonneville Advisory Bd, 811 Oregon St, Portland, Ore., recommends to War Production Bd, construction dam, powerhouse. Priest Rapids, on Columbia River, Washington, $71,266,000; dam, powerhouse, Foster Creek on Columbia River, Washington, $58,986,000; dam, powerhouse, Cabinet Gorge, Washington, $17,026,000; dam, Albany Falls, Idaho, outlet of Pend Oreille Lake to increase storage capacity and regulate flow water to Columbia River, $5,400,000; dam, powerhouse on Columbia River, between Oregon and Washington above Umatilla River, $90,058,000; dam, powerhouse, Detroit, Ore., $26,636,000.

Wash., Ampere—Bids Mar 17, by Bonneville Power Admin, P O Box 3537, Portland, Ore., switchboard panels for substation.

Wash., Longview—Bonneville Power Administration, P O Box 3537, Portland, Ore., plans enlarging substation. $2,750,000.

Wash., Longview—Bids Mar 24, by Bonneville Power Admin, P O Box 3537, Portland, Ore., furnishing two 20,000 kva indoor type, synchronous condensers for substation.

Wash., Tacoma—Bids Mar 23, by A M Angove, clk Bd Contrs & Awards, City Hall, constructing concrete dam, spillway and 51x310 ft power house at Alder; concrete dam, works, tunnel intake structure, 6400 ft diversion tunnel, surge tank and penstocks at La Grande; 50x66 ft La Grande power house addn. Total est $11,000,000.

Wash., Tacoma—Bids Mar 20, by City, furnishing transformers for La Grande and Alder power houses, 2nd Nisqually power development.

W. Va., Huntington—Bids Mar 12, by U S Eng, P O Box 2127, Huntington, furnishing two turbines, accessories for Bluestone Dam power plant, Bluestone Reservoir project, New River.

Wisconsin—Industrial company plans constructing 160x680 ft plant addn. Defense Plant Corp will finance. $3,500,000 incl equip.

Wisconsin—Bids Mar 11, by U S Eng, 408 Federal Bldg, Milwaukee, electrical work, Camp McCoy.

Wis., Waupun—State Dept Pub Welfare, Madison, plans constructing heating and power plant, also small unit to house new boiler and chimney. A H Gesell, Waupun, ch engr. $50,000.

Alaska, Sitka—City plans constructing hydroelectric project. Seeking DPW funds. $254,919.

Middle Atlantic—Industrial company plans constructing plant. Defense Plant Corp will finance.

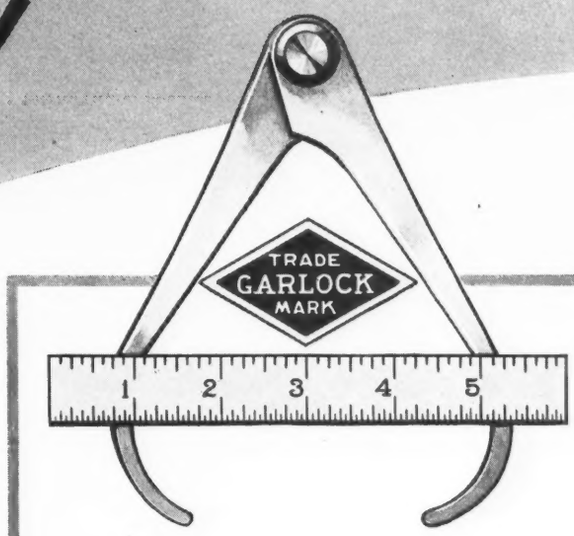
Middle Atlantic—Industrial company plans constructing superstructure for plant, etc.

Middle West—Industrial company plans construting. Defense Plant Corp will finance.

Middle West—War Dept, 20 St and Constitution Ave, N W, Wash., D. C., plans constructing plant. $3,000,000.

South—Yards & Docks, 18 St and Con-

Keep Your Production Rollin'!



Every time a piece of essential equipment is tied up for re-packing or for replacement of gaskets, Victory is delayed a little.

Let's avoid every possible interruption of our all-out production. Use *quality* packings and gaskets for long, dependable service—specify GARLOCK!

GARLOCK

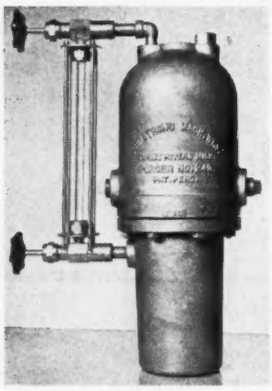
The Standard Packing of the World

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.

Garlock *Plastallic* Packings are compounded to Garlock formulae for various services. Easy to apply. In service, *Plastallic* combines into one homogeneous mass. Photo at left shows coil, spiral and ring forms. Below is shown loose or bulk form.

CUT AMMONIA LOSSES!
Reduce Refrigeration Power Costs!



FOR ANY REFRIGERANT.
Standard Armstrong Purgers are working successfully on Freon, ammonia and butane. Special high pressure units are available for CO_2. Condensation within purger takes place at high side pressure, but at low side temperature. Works automatically. Requires little attention.

ASK FOR BULLETIN!

19 CU. FT. OF AMMONIA GAS LOST
with each cubic foot of air purged is not an unusual figure for the staggering waste that takes place when ordinary *manual purging* is used on a refrigeration system containing a moderate amount of air—4 or 5%.

WITH AN ARMSTRONG AUTOMATIC PURGER, APPROXIMATELY 99% OF THIS WASTE IS REGULARLY ELIMINATED.

Savings in refrigeration power costs reported by users of Armstrong purgers are equally impressive—many have reduced head pressure 25 lbs., or more, with savings of 12½% up in power. Armstrong purgers are working successfully on systems ranging in size from 12 tons up to 1200 tons.

Write today for complete information.

ARMSTRONG MACHINE WORKS
812 Maple St., Three Rivers, Mich.

Backed by a Nation-wide Sales and Service Organization

ARMSTRONG has 50 Factory Representatives located in principal centers in United States, Canada, and Spanish speaking countries. In addition, some one hundred sub-agents represent Armstrong in other centers.

stitution Ave, N W, Wash., D. C., plans constructing plant. Industrial co will operate. $4,500,000.

Southwest—Industrial company plans constructing plant. Defense Plant Corp will finance.

West—U S Eng, 751 S Figueroa St, Los Angeles, Calif., plans constructing buildings. $4,000,000.

Contracts Let

Alabama—War Dept, 20 St and Constitution Ave, N W, Wash, D. C., awarded contract for increasing plant to Sullivan, Long & Haggerty, 2021 2 Ave N, Bessemer, and A Blair, 1st Natl Bank Bldg, Montgomery, Industrial Company will operate.

Ind., Decatur—Bd Pub Wks, awarded contract for boiler work and stokers for light and power plant to F L Ruoff, 2510 Florida St, Fort Wayne, $48,985.

Ind., Whiting—Standard Oil Co of Indiana, 2530 Indianapolis St, will build and operate tuolene plant. Federal financing.

Mass., Hingham—Industrial company awarded contract constructing improvements, to Foundation Company of New York, 120 Liberty St, New York.

Mass., Springfield—Dept P Wks, City Hall, will construct sanitary sewers, Carew St, brick, steel pump station, East Springfield. Owner builds. $45,000.

New Jersey—Pub Serv Electric & Gas Co, 80 Park Pl, Newark, will construct high-voltage transmission line from Burlington to Camden, also addnl low-voltage transmission lines, own forces. A E Banham, 8 Park Pl, Newark, engr. $1,350,000.

N. J., Jersey City—Pub Serv Electric & Gas Co, 80 Park Pl, Newark, will construct boiler house, West End Gas Wks, separate contracts. Over $40,000.

N. J., Rahway—Merck & Co, Inc, 126 E Lincoln Ave, awarded contract constructing filtration plant, water lines, pump plant, to N A K Bugbee Co, 206 E Hanover St, Trenton, $120,000.

N. Y., Syracuse—General Electric Co, Schenectady, awarded contract for design and construction plant to J G White Eng Corp, 80 Broad St, New York. Defense Plant Corp will finance. Est $5,000,000.

Ohio, Cleveland—Industrial company awarded contract for design and construction factory, W 73 St and Denison Ave, to Austin Co, 16110 Euclid Ave. Defense Plant Corp will finance. Total est $4,000,000.

Pa., Bristol—Hunter Mfg Co, 10 and St Marys Sts, Des Moines, Ia., awarded contract constructing plant, to Foundation Co, 120 Liberty, New York, $1,000,000.

Tennessee—Tennessee Valley Auth, Knoxville, awarded contract constructing Douglas Dam in French Broad River, own forces. $30,000,000.

Washington—Bureau Reclamation, Customhouse, Denver, Colo., awarded contract for two generators for Units L-7, L-8 and L-9, Grand Coulee powerhouse, Columbia River Basin Project, Spec 1018, to Westinghouse Electric Co, East Pittsburgh, Pa. $2,792,330.

Wash., Bremerton—Yards & Docks, Navy Dept, 18 St & Constitution Ave N W, Wash., D. C., awarded contract constructing steam boiler and accessory equip, Puget Sound Navy Yard, No 10824, to L C Moore & Co, 451 Mission St, San Francisco, Calif. $90,061.

West Virginia—Industrial company, awarded general contract plant, to H K Ferguson Co, Hanna Bldg, Cleveland, O. Federally financed. $2,000,000.

Bartlett-Snow

SKIP HOISTS

—meet every requirement for handling coal, also ashes, limestone and other abrasive materials when the lift is high, capacities large, and a minimum of care and maintenance are desired. Standard and special designs to provide any hourly tonnage capacity. Eng. Bul. No. 83, sent on request, gives full details. The C. O. Bartlett & Snow Co., 6205 Harvard Ave., Cleveland, Ohio.

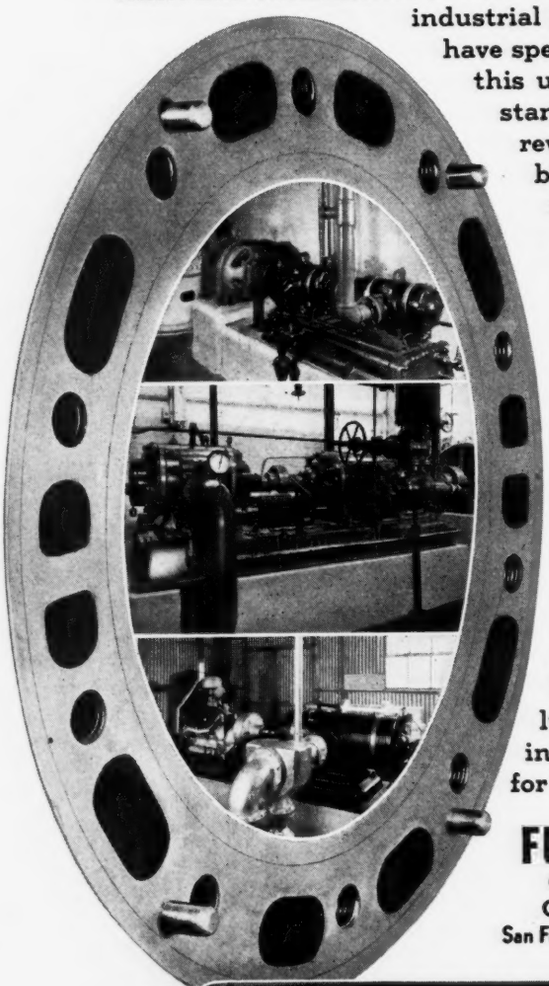
Dependable...

Economical Service

FULLER
ROTARY COMPRESSORS
AND
VACUUM PUMPS

Fuller Rotary Compressors and Vacuum Pumps furnish such dependable and economical service, that of the hundreds now in operation, a great many have been installed on repeat orders.

Industry today is taking advantage of the development and refinements of the Fuller Rotary for general industrial use. Fuller engineers have spent years in developing this unit to its present-day standard. This has had its reward, as is attested to by the reliable and economical service provided the many owners of these machines.



Simplicity makes for reliability and, one of the outstanding features of a Fuller is simplicity of design . . . only three moving parts—rotor, bearings, blades. Other features and advantages of Fuller Rotary Compressors and Vacuum Pumps are illustrated and described in Bulletin C-5. Write for a copy today.

FULLER COMPANY
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San Francisco: 320-321 Chancery Bldg.

New Bulletins

BOILERS AND ACCESSORIES

1 SAFETY WATER COLUMNS—Reliance Gauge Column Co, 5902 Carnegie Ave, Cleveland, Ohio. 16-page catalog No. 414 discusses safety water columns and accessories for steam pressures up to 250 lb. Includes dimension and selection tables, diagramed installation instructions and other illustrations.

2 FLYASH ELIMINATION — Western Precipitation Corp, 1016 W 9th St, Los Angeles, Cal. 24-page book contains flyash collection information with graphs, diagrams, tables of collection efficiencies, methods of preliminary tests and suggestions on procedure.

3 STOKERS—American Engineering Co, Philadelphia, Pa. 8-page catalog discusses operation, advantages and applications of water-cooled Taylor stoker. Includes many photographs and diagrams and lists representative installations.

4 CONTROLS—B F Sturtevant Co, Hyde Park, Boston, Mass. Bulletin No. 446, 28-pages, features vane control for mechanical draft fans. Furnishes data on fan output and power input, fan characteristics, variable-speed control, principle of Sturtevant vane control, etc. Also contains numerous photographs of typical installations.

5 REFRACTORY—A P Green Fire Brick Co, Mexico, Mo. 4-page folder tells how Greencote, refractory maintenance coating, helps operators get greater service from existing furnace linings. Photographs show typical applications.

6 CLEANER—Brunt Equipment Co, 64 South Division St, Buffalo, N. Y. 6-page folder describes the Vibratap, a vibratory cleaner which removes scale by mechanical means which breaks the hold of the deposit on metal and is said to result in complete cleaning. Also illustrates Vibratap for both fire-tube and water-tube boilers.

7 STOKERS—Westinghouse Electric & Mfg Co, East Pittsburgh, Pa. 44-page booklet B-3039 describes continuous-ash-discharge stokers for central stations and industrial plants. Accurate construction, simplified control requirements, and installation economy among features listed. Photographs and line drawings illustrate combustion principles and typical installations.

ELECTRICAL EQUIPMENT

8 POWER DISTRIBUTION — General Electric Co, Schenectady, New York. 16-page booklet GEA-3758 explains basic principles of load-center power distribution for industrial, naval and military projects, shipyards, central stations, and commercial buildings. Also lists chief advantages of system, illustrates available circuit arrangements, and shows typical installations of load-center substations.

9 AC GENERATORS — Westinghouse Electric & Mfg Co, Dept 7-N-20, East Pittsburgh, Pa. 16-page bulletin B-3028 describes large ac generators, from 25 to 2180 kva, for diesel-engine drive, to be used in municipal lighting plants and for industrial emergency power. Discusses rotor and stator constructions, emphasizing effective ventilation, insulation tests, and design features to give lifetime operation.

10 RHEOSTATS—James G Biddle Co, 1211-13 Arch St, Philadelphia, Pa. 4-page bulletin, No. 1705, outlines Jagabi rheostats in four sizes and 76 ratings. Several types illustrated and prices applying given.

11 ROTARY SWITCHES—Roller-Smith Co, Bethlehem, Pa. 16-page catalog, No. 7140, outlines rotary instrument, control, transfer and auxiliary switches. Instrument switches include ammeter, voltmeter, wattmeter, temperature-indicator units, etc. Control switches include those for circuit breaker, motor-governor speed and rheostat control. Diagrams of connections and switch developments shown for each switch listed.

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POWER, 330 West 42nd St, New York 3/42

***—All literature designated with an asterisk (*) may be obtained only by writing directly to the manufacturer on company letterhead, giving writer's name and title.**

12 TRANSFORMERS—General Electric Co, Schenectady, N. Y. 8-page folder GEA-3714 discusses air-cooled transformers insulated by air and solid dielectrics without cooling or insulating liquids, for distribution circuits above 600 volts. Also includes photographs and diagrams illustrating details of construction and care taken in selection and application.

LUBRICATION

13 LUBRICANTS—Fiske Brothers Refining Co, Newark, N. J. 4-page folder outlines Lubriplate No. 130-A (heavy) and No. 130-AA (light) for steel-mill bearings, exposed gears, slides, wire rope and other equipment.

MATERIALS HANDLING

14 MATERIALS HANDLING — Chain Belt Co, Milwaukee, Wis. 16-page bulletin No. 410 discusses Rex belt idlers, apron conveyors, and bucket elevators, their advantages, features, types, sizes, and applications. Photographs show actual equipment installations.

15 MATERIALS HANDLING — Cleveland Crane & Engrg Co, Wickliffe, Ohio. 12-page booklet No. 2008-A, entitled "Cleveland Tramrail Engineering and Application Data" describes line of overhead materials handling equipment. Also contains diagrams and photographs illustrating flexibility of the equipment.

16 MATERIALS HANDLING — Robins Conveying Belt Co, Passaic, N. J. Spiral-bound bulletin No. 115 describes Gyrex, a general-purpose positive-stroke vibrating screen. Each of the four elements making up a Gyrex screen is placed on a transparent insert on succeeding pages, giving the effect of one photograph. This highlights the features of the screen in a novel way. Also includes many dimensional tables and installation photographs.

MECHANICAL TRANSMISSION

17 SPEED CONTROL—Reeves Pulley Co, Columbus, Ind. 16-page booklet No. G-423 illustrates and describes uses and applications for Reeves variable-

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speed control equipment in defense industries and plants on many different machines. Among equipment described in booklet is variable-speed transmission, vari-speed motor pulley and motor drives.

18 SPEED CHANGERS—Allis-Chalmers Mfg Co, Milwaukee, Wis. 20-page bulletin B6013A includes diagrams, operating data and selection tables of speed changer units in sizes handling from 1½ to 75 hp. Also contains numerous photographs illustrating modern speed-changing equipment.

19 CLUTCHES—Morse Chain Co, 7601 Central Ave, Detroit, Mich. 6-page bulletin No. K-6 presents principles, characteristics, advantages and detailed construction of Morse indexing and freewheeling clutch lines. Gives diagramed and charted engineering data, including power-speed ratios, load capacities, complete dimensions and prices.

20 BEARINGS — R-S Products Corp, 4530 Germantown Ave, Philadelphia, Pa. 4-page bulletin No. 11-C explains low unit cost in small or large quantities of standard covers for ball and roller bearings. Also contains detailed drawings, sizes, styles, etc.

21 BELTING—L H Gilmer Co, Tacony, Philadelphia, Pa. 32-page illustrated book, No. 360, entitled "Special-Purpose Belts" describes belts for special applications that involve factors such as speeds, close precision, shock loads, double-friction surface, light duty, etc. Lists multiple and fractional-horsepower V-belts; connected-type V-belting, endless round and endless cord flat belts.

22 SPEED TRANSMISSION — Ideal Commutator Dresser Co, Sycamore, Ill. 52-page handbook includes recommendations, application data, photos and engineering information on variable-speed pulleys, variable-speed transmissions, automatic tension control motor base. Also gives sizes, rated capacities, design and operating details, where applicable, how installed, etc.

METERS, INSTRUMENTS & CONTROLS

24 SMOKE INDICATORS—Brooke Engineering Co, Inc, 4517 Wayne Ave, Philadelphia, Pa. 4-page bulletin No. 11 illustrates electric-eye smoke indicators and recorders with photographs and diagrams. Covers design advantages, construction, lubrication and dimensions.

25 CONTROLS—Brown Instrument Co, Wayne & Roberts Aves, Philadelphia, Pa. Bulletin No. 29-34 describes Brown deaerator control system. Also includes descriptions of principles involved and application data. Schematic diagrams show how system is hooked up for boiler operation.

26 CONTROLS—Hetherington & Berner Inc, 701-745 Kentucky Ave, Indianapolis, Ind. 4-page booklet presents the Fluidometer system of completely automatic control for measuring liquid batches. System resets automatically and is said to be accurate, rapid, and dependable.

27 PYROMETERS—C J Tagliabue Mfg Co, Park & Nostrand Aves, Brooklyn, N. Y. 36-page catalog No. 1101 F outlines Celectray, photocell, electric and light-ray pyrometers with high-speed photoelectric action. A wide variety of Celectray applications shown.

28 RECORDING EQUIPMENT—Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia, Pa. 16-page revised catalog describes recent improvements in Micromax CO_2 recording equipment. Also contains full-size reproductions of round and strip-chart records and illustrations of installations.

29 INSTRUMENTS — C J Tagliabue Mfg Co, Park & Nostrand Aves, Brooklyn, N. Y. 20-page catalog No. 1100B gives descriptions of regular line of precision and standard thermometers, hydrometers, and includes comparison scale graduations, corrections for immersion stems, and instructions for using hydrometers.

30 GAGES—Manning, Maxwell & Moore Inc, Bridgeport, Conn. 1942 general gage catalog, 64 pages lists numerous new gages, streamlined gage cases, gages for special services and Dura-gages. Also illustrates testers and numerous accessories required by gage users.

31 PYROMETERS—Brown Instrument Co, Wayne & Roberts Aves, Philadelphia, Pa. 24-page catalog 15E covers millivoltmeter pyrometers, subdivided into four general classes: indicators, recorders, controllers and safeguards, employed singly or in combination. Contains many photographs and diagrams.

32 INSTRUMENTS—Brown Instrument Co, Wayne & Roberts Aves, Philadelphia, Pa. 16-page data book on Brown boiler-room instruments shows effect of instruments on generation, use and cost of steam. Instruments measuring temperatures, percent CO_2, flows, pressure and liquid levels are described with photographs and diagrams.

33 INSTRUMENTS—Cambridge Instrument Co, Inc, 3732 Grand Central Terminal, New York, N. Y. 4-page leaflet features descriptions of industrial models of analyzers, indicators and recorders. Describes recording gas analyzers, together with pH and other equipment for making precise measurements. Invites inquiries on instrument problems.

34 PRESSURE INDICATORS — Bacharach Industrial Instrument Co, 7000 Bennett St, Pittsburgh, Pa. 4-page bulletin 283 features Premax direct-reading engine-pressure indicator for measuring compression and firing pressures on every type of diesel in the stationary, marine, automotive and aviation fields. Also contains photographs and cross-sectional diagrams.

35 AUTOMATIC CONTROLS — Bailey Meter Co, Cleveland, Ohio. 8-page bulletin No. 103 describes the Standatrol which is said to provide stable, standardizing automatic control under adverse conditions. Book also contains many diagrams illustrating the features, principles and method of operation.

36 PYROMETERS — Wheelco Instrument Co, Harrison and Peoria Sts., Chicago, Ill. Defense Bulletin No. 1 aids instrument users in defense and non-defense industries to gain maximum life and efficiency from pyrometric equipment now installed and being installed. Also suggests substitute materials and compares properties of the original and substitute materials.

37 GAGES—General Electric Co, Schenectady, N. Y. 8-page booklet (GEA-3673) describes available electric gages for measuring mechanical strains and lists examples of stress investigations that can be made. Among these are the determination of stresses on structural parts; housings of rolling mills, beams of shovels and cranes.

38 CONTROLS — Wheelco Instrument Co, Harrison and Peoria Sts., Chicago, Ill. Condensed catalog lists the

(*Continued on page* 164)

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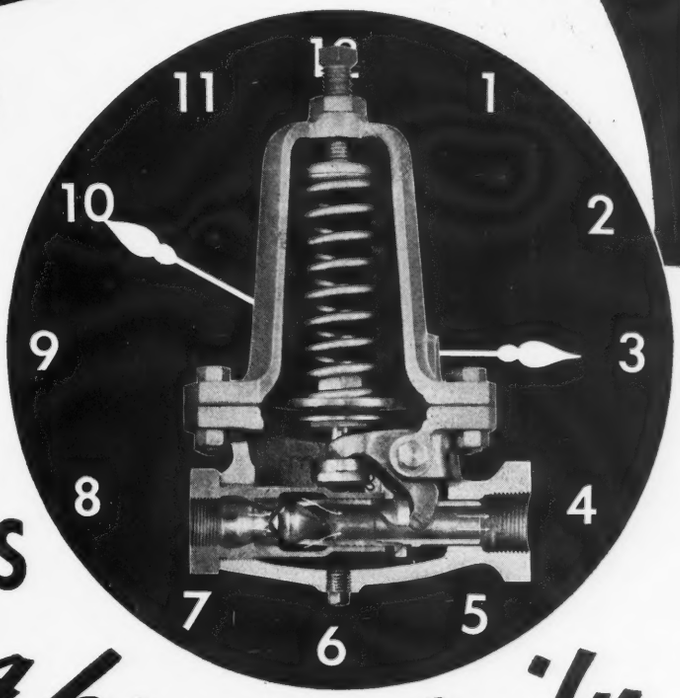

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12. PRACTICALLY ZERO IN MAINTENANCE COSTS

You can find out full details on all of these 12 points by reading Bulletin "1000"—send for it.

CASH STANDARD *Streamlined* TYPE 1000 PRESSURE REDUCING VALVE

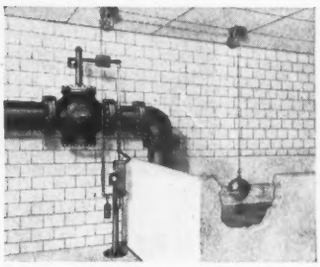
Whether you are operating one, two, or three shifts a day, the "1000" valve, through "Streamlined" performance, is a valuable factor in aiding in smooth operation, high production, and better quality results. Check the twelve points and you will see that you get every advantage in pressure reduction for steam, air, oil—most anything that flows. The "1000" valve stays on the job for years rendering remarkable service—all without giving trouble. The Streamlined flow around the inner valve eliminates turbulence, thereby giving you best control under varying loads. You get better pressure control and greater capacity because there's a straight path for the fluid through the flow tube.

HERE'S THE "1000" FLOW PATTERN
The Streamlined form of the inner valve eliminates turbulence. It produces the flow pattern shown at left which makes for maximum capacity when it is needed most and permits accurate pressure control under toughest working conditions.

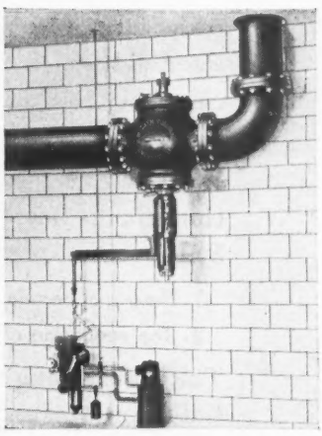
A CASH STANDARD "GET ACQUAINTED" COLUMN

Question: **"Don't you people make anything besides that Streamlined Valve you talk about so much?"**

Answer: **"Yes Sir; we do! And we propose to picture one or two of them here each time."**



In automatic liquid level control, two things are often of prime importance: (1) to hold the level within the closest kind of limits; (2) to do it dependably, day by day. How Cash Standard controls do both is shown above. A Type 100-L Controller operates a 12" Balanced Valve regulating liquid supply to a large tank. It is pilot actuated for sensitivity. It has operating power to spare—for any size Valve, however large.



Here, a Type 100-L Controller operates a 10" Cash Standard Balanced Valve. It regulates flow through a make-up line to a "dirty water" heater on the floor above. The lever of the "100-L" responds to slightest movement of a float in the heater—causing immediate movement of the power piston which operates the Valve. But there is no "hunting" because the Controller is fully compensated. It has a "range" adjustment too. It gets accurate results with any size valve—no matter how small or how large the valve may be. It is simply a matter of using the right size power cylinder.

A. W. CASH COMPANY
DECATUR, ILLINOIS

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"Double Eddy"★ says:
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for Chemical • Rock Product • Metallic • Food • Flue or any other dusts

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principal items of equipment manufactured by company including capacitrols, potentiometers, pressure controls, proportioning controls and thermocouples. Also designates individual bulletins on each control described.

PIPING, VALVES AND FITTINGS

39 EXPANSION JOINTS — American District Steam Co, North Tonawanda, N. Y. 14-page bulletin No. 35-15B gives details of construction, dimensions, specifications, etc, of the Adsco piston-ring type, model A expansion joints, made in sizes from 2-20" for all pressures up to 400 lb.

40 RETURN SYSTEM—Cochrane Corp, 17th and Allegheny Avenue, Philadelphia, Pa. 4-page bulletin, Publ 3025, lists fifty industries using the new Cochrane-Becker high-pressure condensate return system. Also includes a 4-color illustration of a typical installation showing steam, condensate, and makeup lines. Detailed engineering specifications cover the technical features of design and construction.

41 FITTINGS—Hetherington & Berner Inc, 701-745 Kentucky Ave, Indianapolis, Ind. 6-page folder, (S-12), describes company's steam jacketed pipe and fittings and illustrates several practical applications with photographs. Also includes diagrams of eight fittings.

42 VALVES—The Foxboro Co, Foxboro, Mass. 6-page folder describes Stabilflo valves. Photographs, charts and diagrams point out features, such as integral bonnet, guided plunger, wide-range, equal-percentage V-port plunger and Stabilflo motor which has floating power.

43 VALVES—R-S Products Corp, 4530 Germantown Avenue, Philadelphia, Pa. 16-page catalog No. 10-B features standard and special butterfly valves for control and tight shutoff of air, gas, steam, liquids and semi-solids under high and sub-zero temperatures and varying pressures from 2 to 300 psi. Also contains performance characteristics under service conditions.

44 METAL HOSE — Eclipse Aviation Div, Bendix Aviation Corp, Philadelphia, Pa. Bulletin H-201—1935 describes Eclipse seamless flexible metal hose with automotive, aviation, marine, manufacturing, plastics, textile, mining and power-generation applications. Photographs, diagrams and tables of miscellaneous data included.

45 STEAM TRAPS—Sarco Co, Inc, 475 Fifth Ave, New York, N. Y. 8-page bulletin No. 450 covers company's line of floating thermostatic steam traps, compressed-air traps, and liquid-level controls. Photographs, diagrams, descriptions, and list prices are included for each instrument described.

46 FLEXIBLE PIPING—Pennsylvania Flexible Metallic Tubing Co, 72nd St and Powers Lane, Philadelphia, Pa. 8-page bulletin 71 furnishes 1942 standard data for Penflex, all-metal flexible pipes for diesel installations, exhaust pipes, air intakes and supply lines.

PRIME MOVERS

47 TURBINES—Moore Steam Turbine Div, Wellsville, N. Y. 6-page folder, Bulletin 1955, describes type "S" multistage steam turbines with photographs of component parts and a longitudinal section of a typical turbine. Also shows the special features of the "S" type and lists the standard features of Moore turbines.

48 DIESEL ENGINES—National Supply Co, Superior Engine Div, Springfield, Ohio. 16-page bulletin 138 covers 9x12" stationary diesel engines which can be converted into gas engines. Also contains diagrams of engines and principal parts as well as installation photographs.

49 TURBINES—Moore Steam Turbine Div, Wellsville, N. Y. 6-page bulletin No. 1951 illustrates the special features of types GA & GB steam turbines with combined reduction gears. Also contains photographs of typical installations.

50 DIESELS—Nordberg Mfg Co, Milwaukee, Wis. 8-page bulletin 106 discusses Nordberg gas-burning diesels

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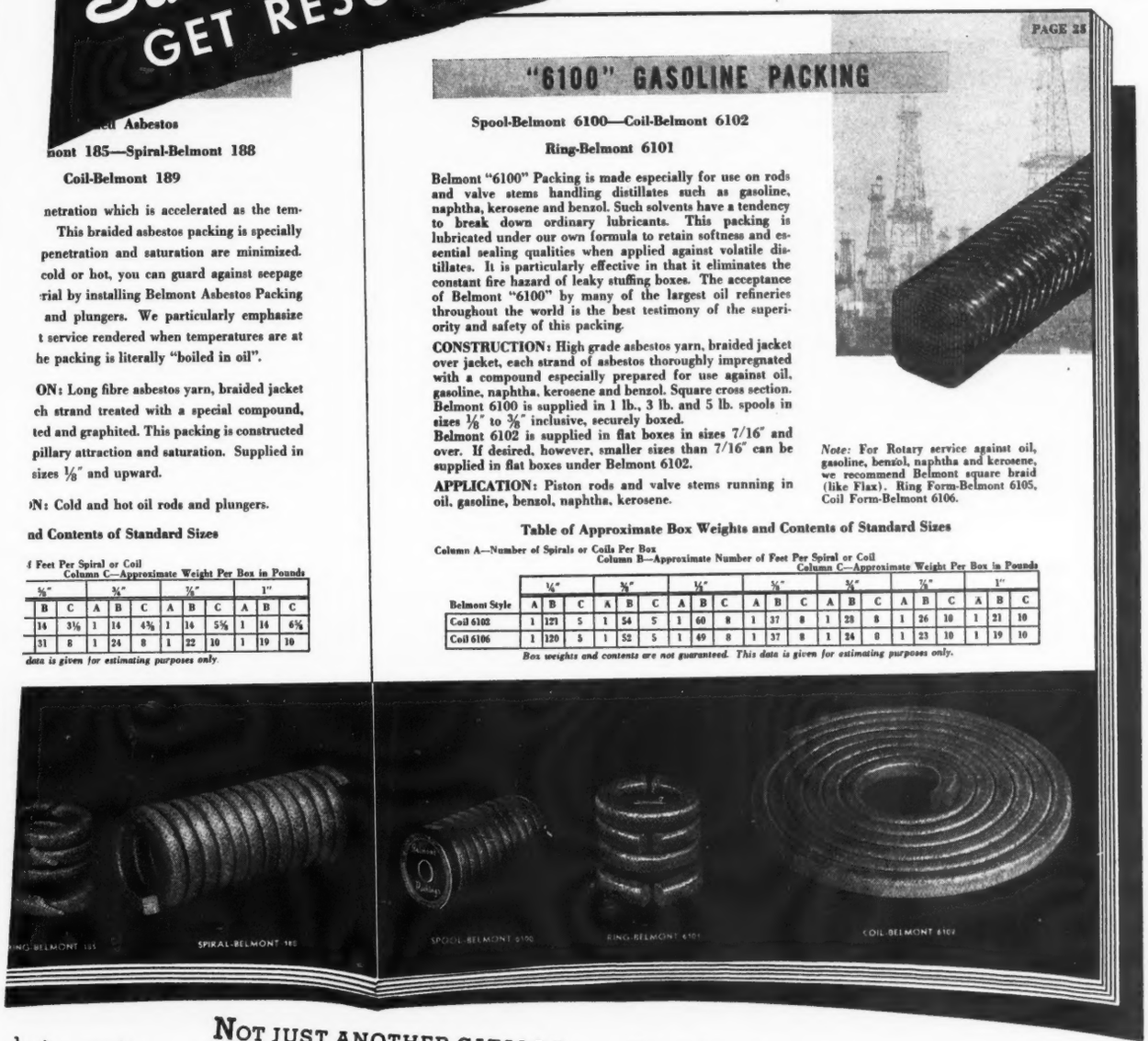

...ell Asbestos

...mont 185—Spiral-Belmont 188

Coil-Belmont 189

...netration which is accelerated as the tem-

This braided asbestos packing is specially penetration and saturation are minimized. cold or hot, you can guard against seepage ...rial by installing Belmont Asbestos Packing and plungers. We particularly emphasize ...t service rendered when temperatures are at ...he packing is literally "boiled in oil".

...ON: Long fibre asbestos yarn, braided jacket ...ch strand treated with a special compound, ...ted and graphited. This packing is constructed ...pillary attraction and saturation. Supplied in sizes 1/8" and upward.

...ON: Cold and hot oil rods and plungers.

...nd Contents of Standard Sizes

...f Feet Per Spiral or Coil
Column C—Approximate Weight Per Box in Pounds

5/16"			3/4"			7/8"			1"		
B	C	A	B	C	A	B	C	A	B	C
14	3 1/2	1	14	4 3/8	1	14	5 3/8	1	14	6 3/8
31	8	1	24	8	1	22	10	1	19	10

...data is given for estimating purposes only.

PAGE 25

"6100" GASOLINE PACKING

Spool-Belmont 6100—Coil-Belmont 6102

Ring-Belmont 6101

Belmont "6100" Packing is made especially for use on rods and valve stems handling distillates such as gasoline, naphtha, kerosene and benzol. Such solvents have a tendency to break down ordinary lubricants. This packing is lubricated under our own formula to retain softness and essential sealing qualities when applied against volatile distillates. It is particularly effective in that it eliminates the constant fire hazard of leaky stuffing boxes. The acceptance of Belmont "6100" by many of the largest oil refineries throughout the world is the best testimony of the superiority and safety of this packing.

CONSTRUCTION: High grade asbestos yarn, braided jacket over jacket, each strand of asbestos thoroughly impregnated with a compound especially prepared for use against oil, gasoline, naphtha, kerosene and benzol. Square cross section. Belmont 6100 is supplied in 1 lb., 3 lb. and 5 lb. spools in sizes 1/8" to 3/8" inclusive, securely boxed.
Belmont 6102 is supplied in flat boxes in sizes 7/16" and over. If desired, however, smaller sizes than 7/16" can be supplied in flat boxes under Belmont 6102.

APPLICATION: Piston rods and valve stems running in oil, gasoline, benzol, naphtha, kerosene.

Note: For Rotary service against oil, gasoline, benzol, naphtha and kerosene, we recommend Belmont square braid (like Flax). Ring Form-Belmont 6105, Coil Form-Belmont 6106.

Table of Approximate Box Weights and Contents of Standard Sizes

Column A—Number of Spirals or Coils Per Box
Column B—Approximate Number of Feet Per Spiral or Coil
Column C—Approximate Weight Per Box in Pounds

	1/4"			3/8"			1/2"			5/8"			3/4"			7/8"			1"		
Belmont Style	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Coil 6102	1	121	5	1	54	5	1	60	8	1	37	8	1	28	8	1	26	10	1	21	10
Coil 6106	1	120	5	1	52	5	1	49	8	1	37	8	1	24	8	1	23	10	1	19	10

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The Belmont Packing Catalog includes recommendation charts that enable you to check instantly, by type of service, Belmont's choice of packing styles (listed in the order of our selection). Packing end views are pictured in large size showing minute details. Construction, applications, tables of weights and measures are all laid out in easily readable form so that everything can be taken in at a glance.

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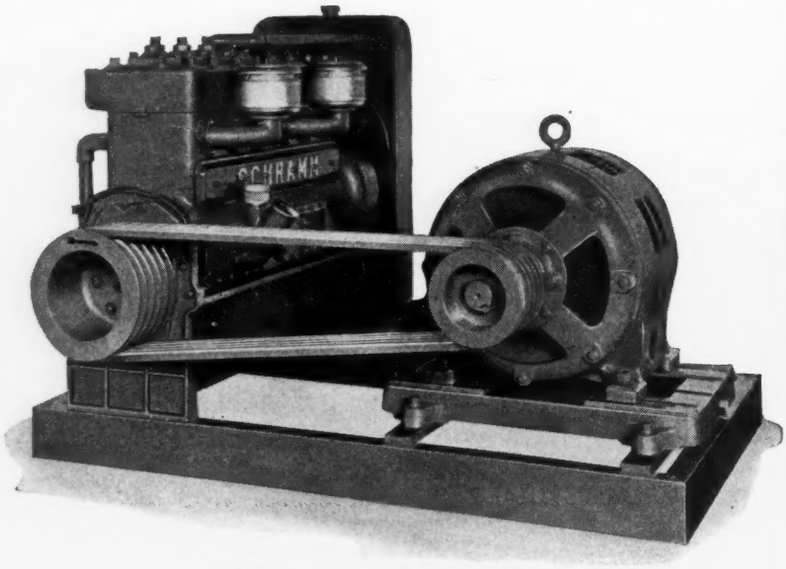


MODEL #315 COMPRESSOR
"V" BELT DRIVE

Precious minutes in America's VICTORY program are saved each day with SCHRAMM Air Compressors.

In all factories from coast to coast, combinations of SCHRAMM Compressed-AIR POWER are contributing to the expanding flow of planes, ships, tanks and guns, in a tremendous effort to emerge VICTORIOUS in this battle to make the "WORLD SAFE FOR DEMOCRACY".

SCHRAMM INC. is building these combinations of compressed air power for operating all kinds of air tools needed for aircraft factories, airports, ship yards, training camps, naval bases, dry docks, power plants and every other important industries.

Time is essential and every weapon made today is worth ten next year. Industries are speeding their production up to maximum capacity—more air is needed for expansion and protection against interrupted power service.

Makes no difference if air requirements are in the shop or out in the yards, or where extension of air lines would be impractical and expensive—SCHRAMM Compressors with their superior performance will give you "AIR WHERE YOU NEED IT", instantly—at low cost.

Built in Sizes 20 to 600 cu. ft. Displacement.

Write for Bulletin #4260

SCHRAMM, INC., WEST CHESTER, PA.

which are quickly converted to natural gas or oil and operate on full diesel principle. Includes typical installation photographs.

PUMPS

51 PUMPS—Chain Belt Co, Milwaukee, Wis. Bulletin 400, 24 pages, discusses Rex Speed Prime pumps made in capacities from 3000 gph to 125,000 gph, their features, and specifications concerning pump design and manufacture. Also contains information on how to pick a pump for a specific job.

52 PUMPS—De Laval Steam Turbine Co, Trenton, N. J. Leaflet entitled "Relation of Suction Head to Capacity with Hot Water Pumps" shows how performance of a pump handling hot water at various temperatures may be correctly deduced from the characteristic curves of the same pump when handling cold water at corresponding suction lifts.

53 PUMPS—Blackmer Pump Co, Grand Rapids, Mich. 6-page folder, bulletin No. 302, contains comprehensive tables of friction losses in pipes, covering viscosities to 2400 SSU, valves and fittings, viscosity conversion tables, tables of practical suction lifts and other data for those interested in pumps and piping layouts.

54 PUMPS — Pennsylvania Pump & Compressor Co, Easton, Pa. 20-page bulletin No. 238 covers Thrustfre multistage centrifugal pumps in the 4-, 5-, 6- and 7-stage series. Pump design said to substantially reduce number of parts subject to wear and replacement.

WATER TREATMENT

55 WATER TREATMENT—Chain Belt Co, Milwaukee, Wis. 6-page folder describes, illustrates and gives technical information concerning Rex Slo-Mixers, which offer operators of sewage and water treatment plants the advantages of the Langlier process of multi-stage flocculation.

56 FEEDWATER TREATMENT—Proportioneers, Inc, Providence, R. I. File No. 1100.26 contains general specifications for high- and low-pressure Adjust-o-feeders with a capacity range from zero to maximum gpm against discharge pressures up to and including 2000 psi. Numerous photographs and diagrams show design details.

57 WATER TREATMENT—Wallace & Tiernan Co, Inc, Newark, N. J. 16-page leaflet entitled "Keep a 'Weather Eye' on Water Quality" cites fifteen actual cases where production problems were solved by microbiological quality control of process water.

58 WATER TREATMENT — Technicraft Engrg Co, 5610 South Soto Street, Los Angeles, Cal. 8-page bulletin features Sterozone water purification without chemicals. Automatic operation filters, sterilizes, controls taste and odor. Many other features covered.

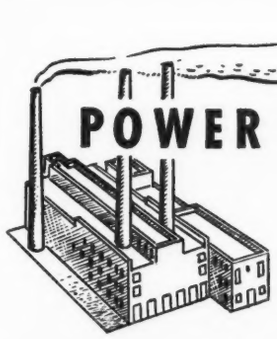
OTHER EQUIPMENT

59 CUTTING AND THREADING — Beaver Pipe Tools, Inc, Warren, Ohio. 28-page 1942 catalog covers complete line of portable pipe and bolt, cutting and threading machines, power drives and power units, pipe reamers, vises, etc. Illustrates and details of each item given.

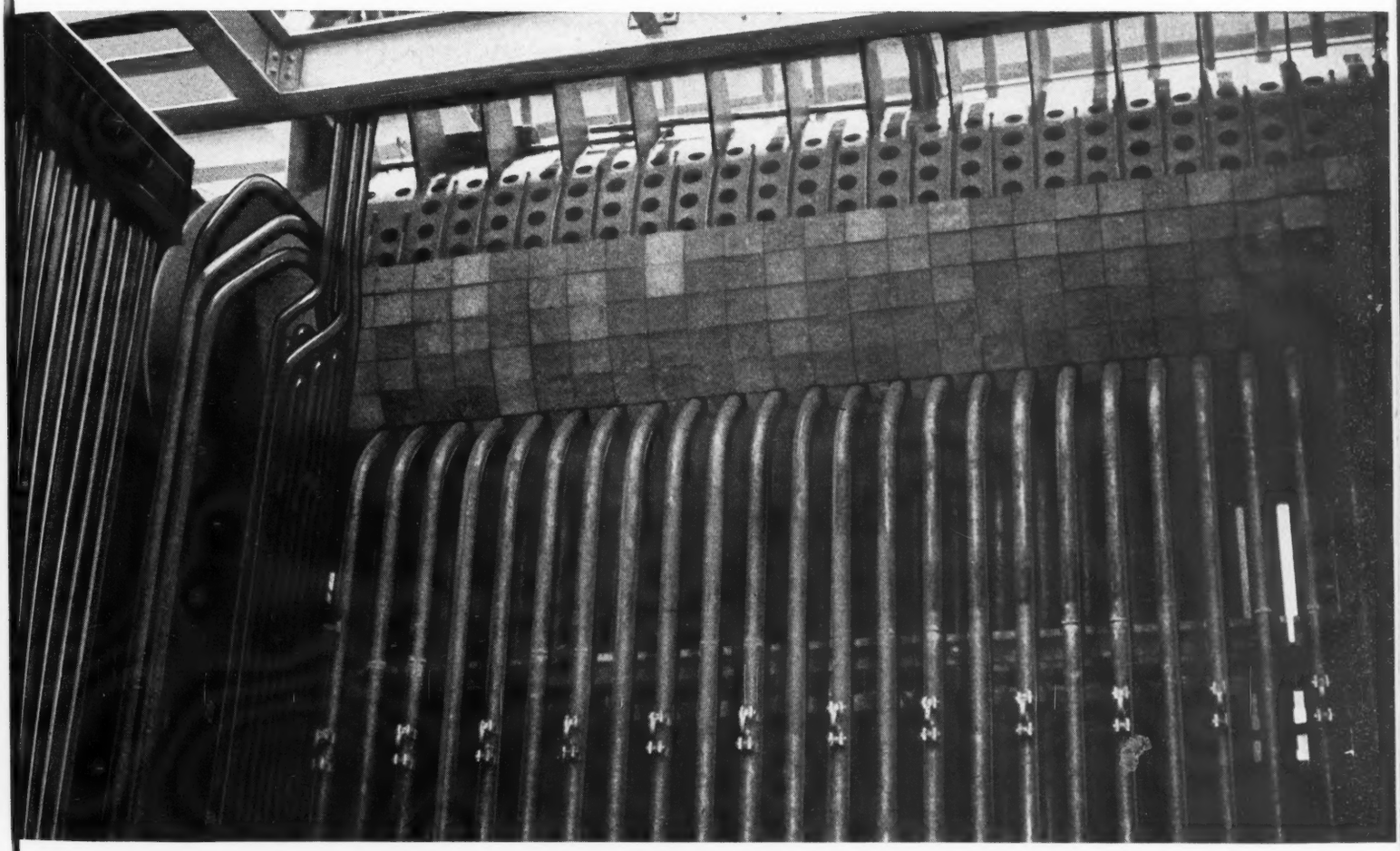
60 PIPE TOOLS—Beaver Pipe Tools, Inc, Warren, Ohio. 4-page condensed catalog on company's line of pipe tools is designed as a reference piece for jobbers' salesmen and covers the same material as general catalog.

61 NUTS—Grip Nut Co, 310 South Michigan Ave, Chicago, Ill. 6-page pocket-size folder answers questions, what, why and how, with regard to Grip Nuts. Illustrates four types of nuts: lock, holding, unit and locomotive, with their respective applications.

62 SHIMS—Laminated Shim Co, Inc, Glenbrook, Conn. 8-page booklet covers the history of the development of industrial and mechanical applications of laminated shims. Also describes use of these shims for fitting machine parts in the original assembly and making service adjustments. Testimonial letters from typical customers in many fields included.



POWER PLANTS ON LAND AND SEA ARE *Vital to Victory*



In the many thousands of plants engaged in the manufacture of armaments or war materials, boilers are essential to Production for Victory. They need Republic ELECTRUNITE Tubes. *They're getting them.*

Many of the ships of our Navy also depend upon steam for operation. They must have boiler tubes. And they, too, are getting ELECTRUNITE Tubes —which are included in U. S. Navy specifications.

So — if you experience difficulty in obtaining Republic ELECTRUNITE Boiler Tubes promptly from your distributor, remember that we're pushing our facilities to the limit to supply tubes for our power plants on land and sea.

Keep in touch with your ELECTRUNITE Distributor. He and we want to help you in every way possible—to provide the electric resistance welded boiler tubes that mean long, trouble-free service for your boilers.

STEEL AND TUBES DIVISION
REPUBLIC STEEL CORPORATION
CLEVELAND • OHIO

Berger Manufacturing Division • Niles Steel Products Division
Union Drawn Steel Division • Culvert Division • Truscon Steel Company

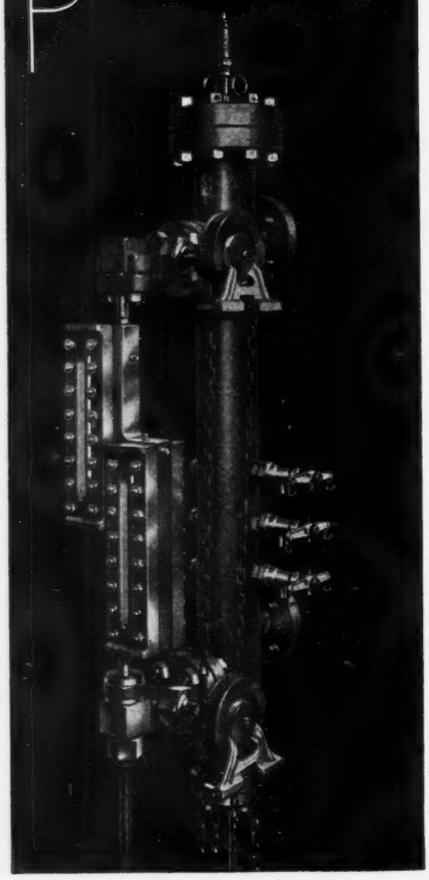
Republic

ELECTRUNITE

Reg. U. S. Pat. Off.

ELECTRIC RESISTANCE WELDED BOILER, CONDENSER AND HEAT EXCHANGER TUBES

POSITIVE Protection



Yarway's unique Hi-Lo Alarm mechanism utilizes balanced *solid weights* that are as indestructible and unchanging as the metal itself. Operating on the displacement principle, they literally "weigh the water level."

When the high or low water emergency occurs—instant, positive, powerful, hair-trigger *action* results—giving warning of danger by whistle, light, or both.

Yarway Water Columns, eight standard models, iron bodies with screwed connections for pressures up to 250 lbs., forged steel bodies with flanged connections for pressures up to 1500 lbs., are fully described in Catalog WG-1807. Write for a copy and working model.

YARNALL-WARING COMPANY
100 Mermaid Ave. Philadelphia

YARWAY
FLOATLESS HI-LO ALARM
WATER COLUMN

63 MAINTENANCE—Oakite Products, Inc, 22 Thames St, New York, N. Y. Digest describes 28 maintenance jobs in connection with prime movers, electrical equipment, compressors, air-conditioning and miscellaneous plant equipment; each outlined, giving material and method used, time saved and other advantages gained.

64 PISTON RINGS — Cooktite Ring Sales Co, 1737 Howard Ave, Chicago, Ill. 12-page bulletin shows relation of piston rings to correcting ring sticking and cylinder scoring in diesel engines. Photographs illustrate reasons for "ring sticking" and cylinder scoring. Booklet also suggests location of oil-control rings for different engines.

65 CLEANERS—Magnus Chemical Co Inc, Garwood, N. J. 24-page bulletin entitled "The Care and Cleaning of Hands and Arms in the Industrial Plant", is designed for safety engineers, plant superintendents. A few phases discussed are: safe detergents and scouring agents, germicides and medicants, lime scums and rinsing, cleaning routines and protection of hands and arms on the job.

66 GRAPHITE—United States Graphite Co, Saginaw, Mich. 12-page booklet tells the history of graphite, and describes applications such as feedwater treatment, electrotyping, pencil manufacture, and many uses in foundries and steel mills.

67 CONCRETE—Atlas Lumnite Cement Co, 135 East 42nd St, New York, N. Y. 16-page booklet describes Atlas Lumnite cement used in making concrete which has full working strength in less than 24 hours. Also points out that booklet is useful for industrial maintenance jobs and for maintaining rush construction schedules.

* WEIGHTS AND DATA — Revere Copper and Brass Inc, 230 Park Ave, New York, N. Y. Fourth edition of "Revere Weights and Data Handbook" includes conversion tables giving equivalents, weights and measures, metric and English, areas of circles and squares, weight conversion factors, and weights per lineal foot, of copper, brass and bronze products.

68 LIGHTING—Goodrich Electric Co, 4600 Belle Plaine Ave, Chicago, Ill. Pocket-size folder deals with the present urgent need for protective lighting around industrial plants. This folder illustrates various styles of porcelain enameled floodlights available to meet the demands for illumination in different locations. All equipment listed is in accordance with FBI specifications.

69 INDUSTRIAL PRODUCTS—Johns-Manville, 22 East 40th St, New York, N. Y. 52-page book, GI-6A, contains recommedations on high- and low-temperature insulation for industrial needs from 400 F below zero to 2500 F above. Complete data also included on J-M refractory products and castables.

70 LEAD AND TIN PRODUCTS — Alpha Metal & Rolling Mills Inc, 363 Hudson Ave, Brooklyn, N. Y. 4-page folder entitled "Alpha Lead & Tin Products" includes lead-tin alloy tables and describes varying alloys-solders, extruded shapes, pipe and tubing and other specialties.

71 SAFETY PRODUCTS — Kimball Safety Products Co, 7314 Wade Park Ave, Cleveland, Ohio. Folio contains four separate catalogs covering eye, body and hand protection, and welders supplies. Each illustrates numerous safety products in respective fields.

72 WROUGHT-IRON PRODUCTS — A M Byers Co, Pittsburgh, Pa. 61-page spiral-bound general catalog covers company's wrought iron, tubular and hot-rolled products, steel tubular products and alloy steels. Many photographs, diagrams and tables illustrate product features.

73 POWER TRANSMISSION — Power Transmission Council, Inc, 53-63 Park Row, New York, N. Y. 16-page booklet entitled, "Modern Mechanical Power Transmission for Industry" is nontechnical and attempts to show the necessity of really designing the drives in any plant and how to choose the proper drive for each job. Provision has been made for private companies to distribute this booklet, which covers the general field of mechanical transmission.

PALMETTO PETE says

NON-SCORING
PALMETTO*
saves shafts, rods, stems

Palmetto Self-Lubricated Packing makes a hit with plant engineers and maintenance men because it saves them repacking time, labor and expense.

Pumps, valves, and other equipment give longer, more trouble-free service when packed with Palmetto, because its abundant graphite lubricant protects shafts, rods and stems from scoring.

Free **WORKING SAMPLE**

Just send us your name and address, stating size and operating conditions for packing, and a generous sample will be sent you without charge or obligation.

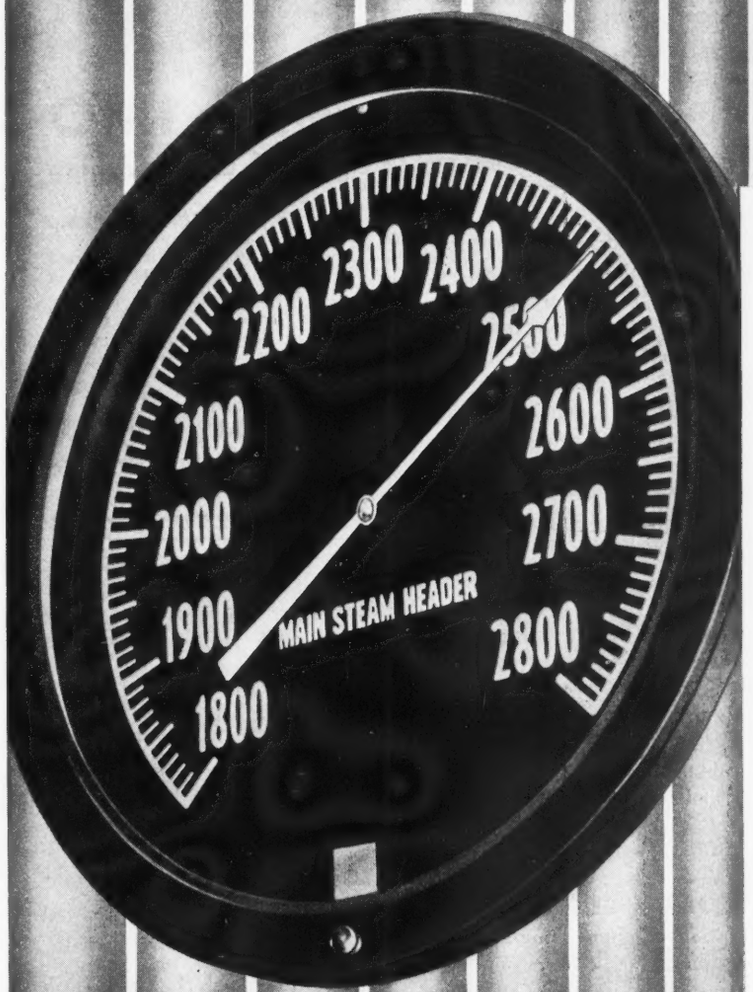
*Reg. U. S. Pat. Off.

GREENE, TWEED & COMPANY
Bronx Blvd. at 238th Street
New York N. Y..

PALMETTO
for steam, hot water, air.
PALCO *for water.* PELRO *for oils.* CUTNO *for alkalis.*
SUPERCUTNO *for acids.*
KLERO *for foods, etc.* PALMETTO SUPERSHEAT
PACKINGS

9 out of 10 who try them, buy them

TIME, TUBES *and* PRESSURES



Every minute counts in winning the war. Every minute lost in shutdowns is lost production. Babcock & Wilcox Tubes are good insurance against delays due to necessity of tube replacements. Service records of B&W Tubes in boilers operating at pressures as high as 2500 lb. per sq. in. have proved the reliability of these tubes.

Whatever your boiler pressures, whatever the service, you can depend upon B&W Tubes

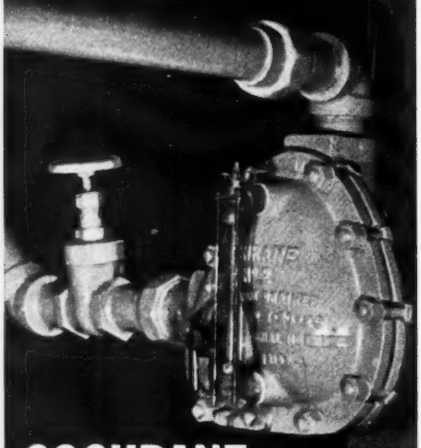
TA-1197

BABCOCK & WILCOX TUBES

HOT FINISHED COLD DRAWN ALLOY STEELS CARBON STEELS

THE BABCOCK & WILCOX TUBE COMPANY, BEAVER FALLS, PA.

DRAINING
LARGE QUANTITIES OF LOW PRESSURE, DIRTY
CONDENSATE
with



COCHRANE
Multiport
DRAINERS

at S. D. WARREN CO.'s
Cumberland Mills, Maine
• PAPER MILL •

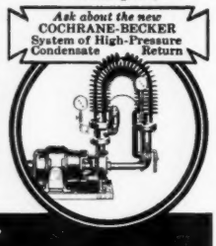
MANY Cochrane Multiport Drainers are in use at the Warren Cumberland Mills plant as they are in many other paper mills. The reason for their satisfactory operation is told by Mr. F. L. Wellcome, steam engineer at this plant: "These traps discharge continuously, the valve opening being determined by the height of water in the float chamber; the larger the volume of water, the larger the valve opening. The rotating movement of the sleeve valve serves to keep the valve free of sludge accumulation."

Write for Publication 2925 on Multiport Drainers

COCHRANE CORPORATION
3106 N. 17th St. Philadelphia, Pa.

Rapidly removes hot condensate from steam process equipment and returns it to boiler at high pressure and close-to-process temperature. IMPROVESQUALITY, INCREASES PRODUCTION, CUTS COSTS.

Ask about the new COCHRANE-BECKER System of High-Pressure Condensate Return



Cochrane

Power Lines

(*Continued from page* 122)

experience has been associated with the company for the last 2½ years as assistant to the president.

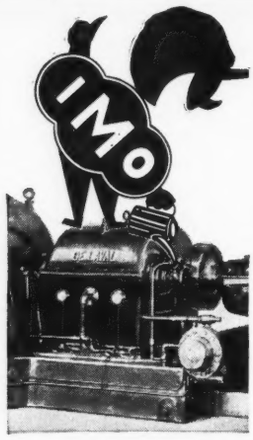
HARRY E SMITH, general manager of the Manhattan Rubber Division of Raybestos-Manhattan, Inc, was elected a member of the board of directors of the Rubber Manufacturers Association at a meeting of the Board of Directors held recently. Mr Smith replaces F L Curtis, former general manager of the Manhattan Division, who resigned.

ALBERT R MUMFORD has been appointed to the research department of the Combustion Engineering Co, Inc, New York. Mr Mumford was for four years an assistant fuels engineer of the U. S. Bureau of Mines, and 15 years a research and design engineer with the New York Steam Corp. From Oct 1938 to Feb 1942, was assistant director of research of the Consolidated Edison Co of New York. He is a member of the American Society of Mechanical Engineers, the National District Heating Association, the American Society of Heating and Ventilating Engineers, and the American Society for Testing Materials.

JOHN R HOOVER has been appointed manager for synthetic sales of the B F Goodrich Co. Hoover succeeded Dr H E Fritz, who was recently named company director of research. He had been manager of rubber-lined equipment sales since 1935, and is succeeded in that post by Herman C Klein, who had been sales engineer in the department.

EDWIN L DENNIS, chief combustion engineer of the Coppus Engineering Corp, has requested to be released of his duties as instructor at the Louisiana State University, Baton Rouge, La. This request was made by Mr Dennis so that he could "devote his full energies to the increasing vital problem of efficient combustion in engineering plants." Mr Dennis has been associated with the development of the Coppus-Dennis Fanmix Gas Burner.

FRANK B BATCHELOR, who for the past six years has been a member of the sales staff of the Bridgeport Brass Co. in the Detroit area, has been appointed district manager. Mr Batchelor came with the Bridgeport Brass Co in 1936, and was sent immediately to the Detroit district office. Before joining the sales



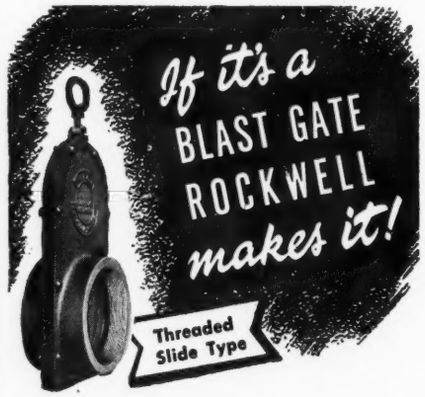
Make IMO
part of your machine

The De Laval-IMO Oil Pump

can be built into your machine and can be connected directly to a high speed member of the machine served. There are no valves, no separate bearings, no gears and no packings. Sounds simple, doesn't it?

Ask for Catalog 1-86

IMO PUMP DIVISION
of the De Laval Steam Turbine Co.
Trenton, New Jersey



ROCKWELL'S complete line of Blast Gates includes all types: Slide, Kwikleen, Wafer, and Butterfly, in sizes up to 48". They are quick and easy to operate—strong, light, and durable. They can be supplied in monel, bronze, stainless steel and other alloys to meet individual requirements.

Write for catalog 4020, W. S. Rockwell Co., 50 Church Street, New York.

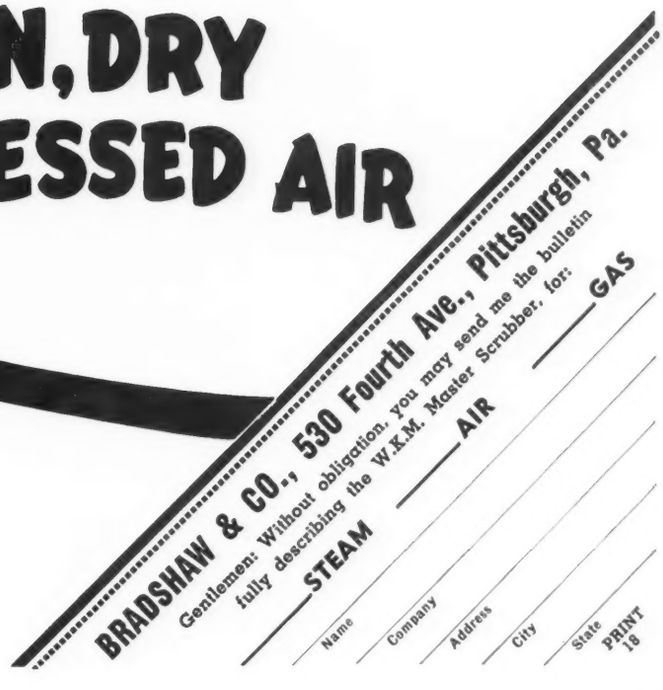
★ Rockwell ★
BLAST GATES

W-K-M MASTER SCRUBBER

THIS IS **NOT** THE BURMA ROAD

...IT'S THE ROAD TO

CLEAN, DRY COMPRESSED AIR



A TOUGH JOB?

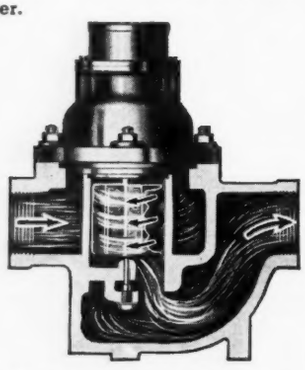
HENSZEY
BOILER FEED WATER
METERS

WILL DO IT!

. . . and that's important today with increased, uninterrupted production the by word of all industrial effort. Henszey Feed Water Meters are of rugged construction—able to withstand unusually hard use under abnormally difficult conditions. They have been successfully used for such hard-to-measure liquids as:

- Hot Dirty Boiler Blowdown
- Condensate
- Boiler Feed Water
- Free Running Chemicals

Henszey Feed Water Meters are equally accurate at high or low flow, high or low pressure, on reciprocating, duplex, triplex or centrifugal pumps. They can be calibrated to read in Gallons, Pounds or Cubic Feet at any specified temperature. Sizes 10 to 600 G.P.M., cold water steady flow rating. Connections: ¾" to 6". Special sizes to order.



Here's how it works

Water enters the measuring chamber tangentially, spinning in the chamber as it passes through, forming a vortex. Each gallon that passes through this chamber makes the same number of revolutions of the water. A vane is placed in the rotating water to impart this rotation to the register.

HENSZEY COMPANY
Dept. D4 Watertown, Wis.

HENSZEY

staff of the Brideport Brass Co, he was for many years technical sales engineer for the Revere Brass & Copper Co.

J G GREEN, of Milwaukee, has been made assistant general manager of the storage battery division of the Philco Corp. Mr Green was formerly with the Westinghouse Electric & Mfg Co for eleven years. In 1935 he established the J G Green Co in Pittsburgh, Pa., to provide engineering services. Since Jan 1940, Mr Green has been assistant sales manager of the Louis Allis Co in Milwaukee.

ELMER J WEIS, former aircraft parts manager, has been elevated to the vice-presidency of Pacific Pump Works. For the past several years he has been identified with many engineering improvements in the company's line of centrifugal pumps. He has been with the Pacific Pump Works since its organization in 1923.

COL WILLIAM KELLY, president of the Buffalo, Niagara & Eastern Power Corp, has been made an honorary member of the American Society of Civil Engineers. Such honorary membership in the ASCE has been awarded to only 28 persons in the United States, and are limited to those of "acknowledged eminence in engineering."

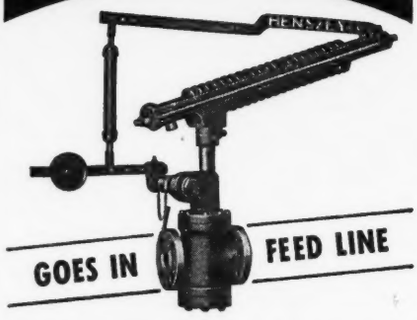
EDWIN H BROWN has been elected a vice-president of the Allis-Chalmers Mfg Co, Milwaukee. Before assuming the new post, in which he will correlate all engineering activities and development of new products, Mr Brown was manager and chief engineer of the engine and condenser department for seven years. Mr Brown entered the Allis-Chalmers training course immediately following his graduation from the University of Nebraska in 1906.

WILLIAM C BELL, vice-president of the New England Power Association, Boston, since 1928, has been elected president of the United Illuminating Co, New Haven, Conn., succeeding James W Hook, newly elected chairman of that utility. Mr Bell worked as a substation operator, load dispatcher and chief engineer of utilities in various parts of the country before going to New England.

BUSINESS ITEMS

GENERAL ELECTRIC Co announces further personnel changes. Harry F McRell has been appointed assistant manager of General Electric transformer

HENSZEY
BOILER FEED
REGULATORS



The Henszey Boiler Feed Regulator controls boiler water levels continuously and accurately under *all* load conditions!

These simple, compact, self-contained units go right in the feed line and require no additional structural support. They are as easy to install as a simple gate or globe valve. Once installed and set for operation no further attention is necessary — nothing to get out of order—nothing to reset.

Send for latest Bulletin containing full details.

HENSZEY COMPANY
Dept. D4—Watertown, Wis.

HERCULES
Seamless Copper
FLOATS

GUARANTEED
TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

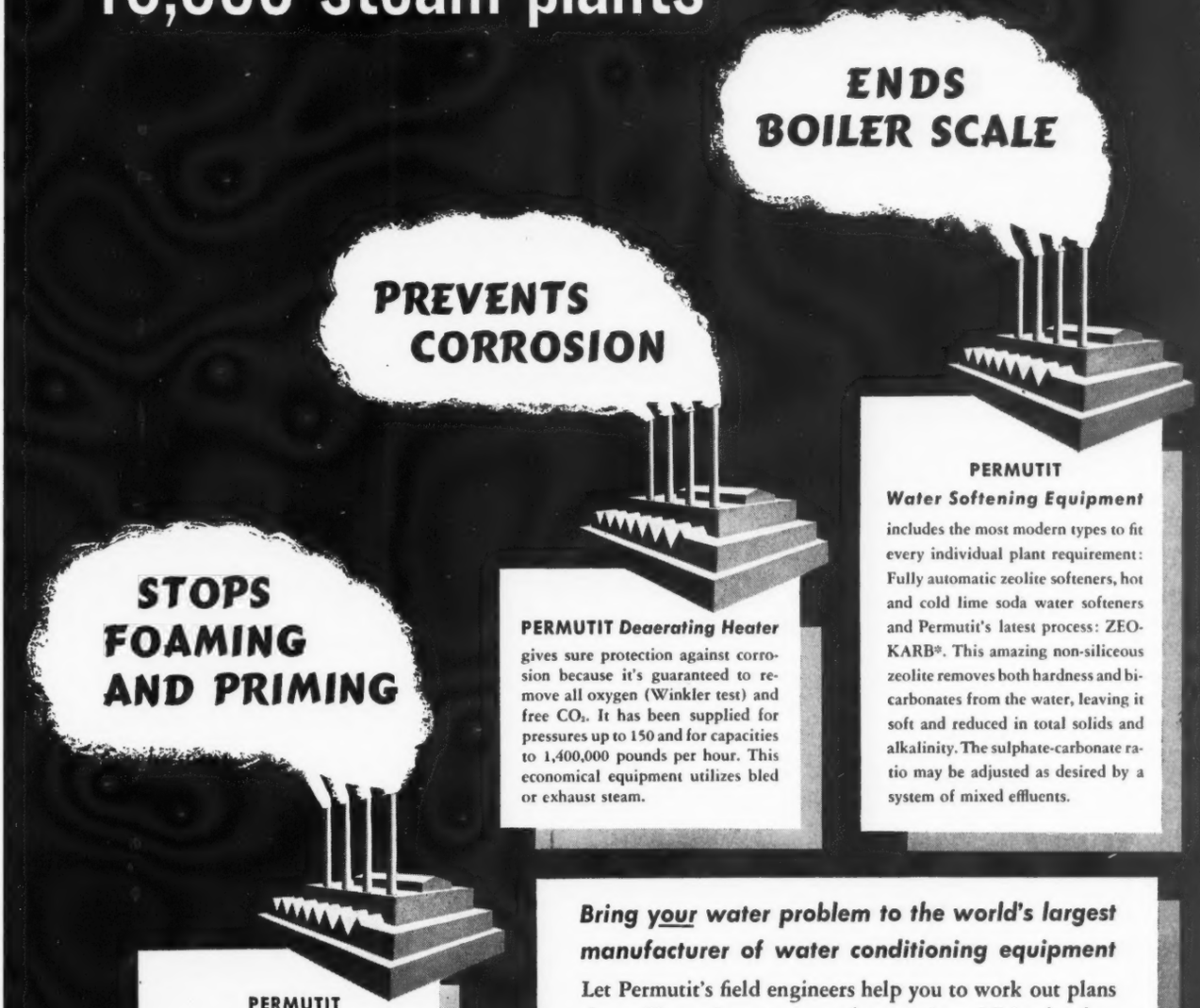
Fabricated of seamless copper under our special spinning process. Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

HERCULES FLOAT WORKS
200 Franklin St.
SPRINGFIELD, MASS.

How Permutit* boiler feedwater treatment speeds production for 10,000 steam plants



PERMUTIT ***Deaerating Heater***

gives sure protection against corrosion because it's guaranteed to remove all oxygen (Winkler test) and free CO_2. It has been supplied for pressures up to 150 and for capacities to 1,400,000 pounds per hour. This economical equipment utilizes bled or exhaust steam.

PERMUTIT
Water Softening Equipment

includes the most modern types to fit every individual plant requirement: Fully automatic zeolite softeners, hot and cold lime soda water softeners and Permutit's latest process: ZEO-KARB*. This amazing non-siliceous zeolite removes both hardness and bicarbonates from the water, leaving it soft and reduced in total solids and alkalinity. The sulphate-carbonate ratio may be adjusted as desired by a system of mixed effluents.

PERMUTIT
Continuous Blowoff

maintains a uniform concentration of salts in the boiler salines. Both high and low flash types. Heat from the blow-off water is recovered by means of flash tanks and heat exchangers, resulting in appreciable savings. Available in a number of types to suit specific heat balance requirements.

Bring your water problem to the world's largest manufacturer of water conditioning equipment

Let Permutit's field engineers help you to work out plans that will get the most out of your plant. Write for free booklets: The Permutit Company, Dept. A, 330 West 42nd Street, New York, N. Y.

In Canada, call upon the Permutit Company of Canada, Ltd. . . . Montreal . . . Toronto . . . Winnipeg . . . Calgary.

*Trademark Reg. U. S. Pat. Off.

PERMUTIT

WATER CONDITIONING HEADQUARTERS

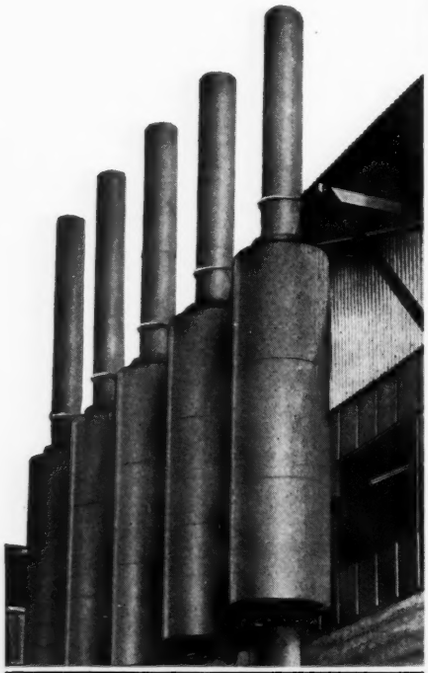
NOISE ABATEMENT PAYS DIVIDENDS

Today we cannot afford to overlook any factor that will increase the efficiency of plant operation.

Noise has long been recognized as a disturbance distinctly detrimental to work efficiency. With Maxim Silencers you can eliminate some of the most penetrating plant operation noises . . . those due to internal combustion, engine exhaust or intakes, compressor intakes and steam blow-offs.

Maxims can help not only your own plant operation but public relations with your neighbors too. Consult Maxim.

The Maxim Silencer Co.
92 Homestead Ave., Hartford, Conn.



MAXIM
SILENCERS

division of the Central Station Department. Harold M Jalonack succeeds Mr McRell as manager sales for distribution transformer and feeder voltage regulators. F W McChesney and Neal L Parker of the company's industrial department, have been appointed assistant manager, sales respectively of the industrial manufacturers section and of the machinery manufacturers section. Mr McChesney has been with the company since 1918, and Mr Parker joined General Electric in 1920.

Osborn Manufacturing Co, Cleveland, Ohio, is observing its 50th year of continuous operation under the leadership of Franklin G Smith. When Mr Smith first became president of the company its staff consisted of one foreman, two men, two girls and three boys. Today, his company's payroll comprises 768 persons. In commemoration of his 50 years of service as president of the Osborn organization, two perpetual Franklin G Smith scholarships have been established in the School of Engineering of Fenn College in Cleveland.

The New York office of W H & L D Betz, at 50 Church St, is now under the direction of V W Hooper. R H Hayman has been advanced to the position of assistant district manager of the Betz offices and laboratories in Chicago. A B Baner has been assigned to the New England territory. Howard E Jordan is replacing Mr Baner in the North Jersey territory. W P Woodward, chemical engineer, has recently been transferred from the Detroit, Mich., territory, to the Wichita, Kans., district. R C Wardlow, chemical engineer, has been placed in charge of sales correspondence in the Philadelphia office.

Manhattan Rubber Division, Raybestos-Manhattan, Inc, announces changes. W L White, director of laboratories, and H Snyder, manager of the roll covering and tank lining departments, are now factory managers. H H Burrows has been appointed manager of the roll covering and tank lining departments, and P A Cady will be laboratory manager. F L Curtis, general manager of the company, has been named a vice president. H E Smith, assistant general manager, was appointed to succeed Mr Curtis as general manager. J H Matthews, assistant factory manager, is now assistant general manager.

The Frederick Post Co, Box 803, Chicago, Ill., announces that confidential expert advice is offered to government contractors and subcontractors on a time-saving method of reproducing drawings required under the govern-

Send for
this FREE
DIGEST
A DIGEST OF
28
essential maintenance jobs generally performed in factories and mills and on which Oakite materials are being successfully used to save time, money and effort.

It's NEW! It's TIMELY... tells how 28 essential power plant maintenance jobs can be handled EASIER and FASTER!

War conditions are multiplying maintenance problems of every power plant, central station and public service company. Here in this Digest you will find data on 28 different jobs, each one based on the successful experience of many plants. On each is outlined the method followed, the Oakite material used, the advantages gained, the time saved.

You will have many of these maintenance jobs to do in your plant. Here is your opportunity to benefit by what others have discovered to speed-up this essential work and increase efficiency in handling these jobs.

Write for Your Copy Today!

Time is at a premium these critical days. This Oakite Digest points out proved ways to save it and conserve man-hours for other work. Address us on your business letterhead and your **FREE** copy will go forward immediately. Send for it today!

OAKITE PRODUCTS, INC.
23 Thames Street, New York, N. Y.
Representatives in All Principal Cities of the United States and Canada.

OAKITE *Specialized cleaning*
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

Why 10 REASONS you can bank on FAIRBANKS

Extra Service Value At No Extra Cost

Fairbanks Valves—with more than half a century's service record and acceptance behind them —are definitely *quality* valves.

In addition to correct design, careful selection of materials and accurate workmanship, Fairbanks offers features which contribute to dependable performance, low upkeep and outstanding endurance. Yet Fairbanks Valves and Fairbanks performance are available at standard prices.

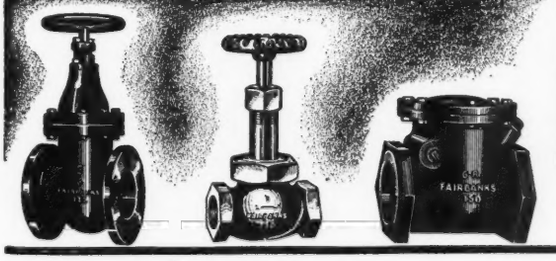
Never was there a time when it was so important to choose valves that you can depend on . . . *quality* valves that will give you long, trouble-free service.

The Fairbanks Distributor in your territory is ready to serve you. Write us for his name if you don't know it. Also ask for Catalog No. 21.

1. Prompt service through conveniently located distributors.
2. Standard and Renewable types for practically every need.
3. Quality in design, materials and workmanship.
4. Uninterrupted service.
5. Low in maintenance cost.
6. Maximum years of service assured.
7. Acclaimed for dependable performance.
8. Nationally accepted by users.
9. Backed by over 50 years' specialized experience.
10. Technical assistance in valve selection.

THE FAIRBANKS COMPANY
397 Lafayette St., New York, N. Y.
Boston, Mass., Pittsburgh, Pa.
Factories: **Binghamton, N. Y., Rome, Ga.**

You can bank on...



FAIRBANKS

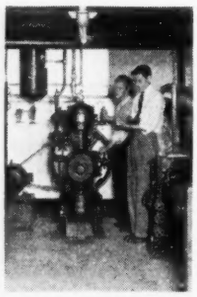
as the **RIGHT VALVES TO USE**

No one would enter a battle with guns that wouldn't fire, or with machines that wouldn't run.

In the Battle of Production your equipment must also perform without failure. Hundreds of businesses and industries depend on refrigerating equipment as a vital part of their work. Warm weather, with its heavy loads—and overloads—will soon be here. Time now to have a check-up made of your cooling system.

A survey by a Frick Refrigerating Engineer will tell you not only what parts are dangerously worn, but whether you can save power, water, and labor, by the use of up-to-the minute equipment such as evaporative condensers and automatic controls. A few changes might materially increase the cooling capacity of your present system. And replacement parts are still available.

Be ready to fight hot weather! Get in touch with your nearest Frick Branch or Distributor now.



Get the advice of the nearest Frick Refrigerating Engineer on how to solve your cooling problems.

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA. U.S.A.

How to analyze and correct troubles of any type oil burner DOUBLE-QUICK

C. H. CHALMERS

Pres., Chalmers Oil Burner Co.; Former Pres., American Oil Burner Assn., says, "No one installing or servicing burners should neglect to read this well-written and informative manual."

Today's money-making opportunities in oil burner servicing are keyed not only to how well the work is done but how fast. With this practical book you can locate, diagnose and correct all operational and constructional troubles of any type or recognized make burner without delay or doubt—and thus increase earnings.

OIL BURNER SERVICE MANUAL

By K. STEINER
Consulting Engineer, Ray Heat & Power Co.
and F. RAVNSBECK
Chief Engineer, Ace Engineering Co.

365 pp., 6x9, illus., $4.00

Gives the mechanic just the help he needs in installing and servicing oil burners, in plain language. Exhaustive treatment given to domestic burners, including all recognized makes from earliest to current types. Commercial and industrial installation, maintenance and service are thoroughly discussed and illustrated. Gives countless pointers secured from men actually engaged in handling the various burners and accessories.

16 CHAPTERS COVER:

- Domestic Pressure-atomizing Oil Burners.
- Domestic Vertical-cup Burners.
- Rotary Wall-flame Burners.
- Low-pressure Atomizing Domestic Burners.
- Miscellaneous Domestic Burners.
- Horizontal-rotary Oil Burners.
- Miscellaneous Industrial Oil Burners.
- Refractories.
- Tanks and Piping.
- Relays and Circuits.
- Automatic Control Instruments.
- Boilers and Warm-air Furnaces.
- Load and Burner Capacity.
- Draft and Control, Efficiency and Testing.
- Preheating.
- Service.

MAIL COUPON FOR 10 DAYS' FREE TRIAL

McGraw-Hill Book Co., 330 W. 42nd St., N. Y. C.
Send me Steiner and Ravnsbeck's Oil Burner Service Manual for 10 days' examination on approval. In 10 days I will send $4.00 plus few cents postage, or return book postpaid. (Postage paid on orders accompanied by remittance.)

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Company P-4-42

ment contracts. Requests for information should state whether contracts are held for the Army, Navy, Air Corps, or whatever governmental department is involved. All requests must be made on company letterhead and signed by a company officer.

The commercial forces of the EDISON ELECTRIC INSTITUTE will be in Chicago again this spring for a general power conference. The dates set are March 24, 25 and 26, at Edgewater Beach Hotel, Chicago. Conference will be preceded by a Committee Day on March 23. Tentative plans provide for the elimination of sectional conferences. There will be general sessions only, all of which will be open to manufacturers and others interested in electric service supply.

At the annual meeting of the IRONTON FIRE BRICK CO, E F Meyers was elected president, treasurer and general manager; C E Bales and W P Lewis were made vice presidents, and Wm D Lewis was made secretary.

The former mechanical goods and sundries sales divisions of the B F GOODRICH CO, have been combined and given a new name, the Industrial Products Sales Division, as announced recently. B F Stauffer, division assistant general manager in charge of Miller plant activities; L H Chenoweth is manager of manufacturers' sales; C F Conner is manager of distributor sales; C O Delong is manager of operations, and the set-up includes the following department managers: P W Van Orden, J F Johnston, G K Ryan, H C Klein, F A Lang, J M Failey, H A Bauman.

THE HARTFORD STEAM BOILER, INSPECTION & INSURANCE CO announces the election of William R C Corson as chairman of the board, following 15 years as president. Curtiss C Gardiner, vice-president and a director, has been elected president, and C Edgar Blake, secretary, has been made treasurer. Lynn D Brainerd and John M Gorham have been made vice-presidents, while H Crowell Freeman has been elected assistant treasurer, and L G Wimmer, assistant vice-president.

MAXIM SILENCER CO announces the appointment of Edgar E Huff, formerly sales manager of the Hill Diesel Engine Co, as manager of the Mid-West sales office in Chicago. He succeeds William A Damerel, who has been transferred to the production department in Hartford, Conn.

☆

AN ARMY, NOT
IN KHAKI OR BLUE

. . . but on the march for you!

From coast to coast Morse dealers, distributors and sales engineers are attacking power transmission problems to keep your production up to war needs. No task is too great or small for this army of front line power veterans. They are trained power specialists, tried and practical—working to fulfill your demands. All are backed up by the vastly expanded Morse engineering and production facilities. ¶ For sound counsel and rapid solution of power transmission problems call on these men.

SILENT CHAINS ROLLER CHAINS FLEXIBLE COUPLINGS

MORSE *positive* DRIVES

MORSE CHAIN COMPANY ITHACA N. Y. DIVISION BORG-WARNER CORP.

UNSHAKO

SELF-LOCKING NUT

STAYS PUT

Saves maintenance time, reduces breakdown troubles. Write for bulletin.

STANDARD PRESSED STEEL CO.

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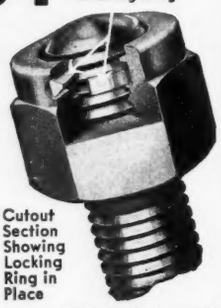
BOSTON • DETROIT • INDIANAPOLIS • CHICAGO • ST. LOUIS • SAN FRANCISCO



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PRECISION GAGE GLASSES and GAGE GLASS GASKETS THAT WILL NOT BLOW OUT

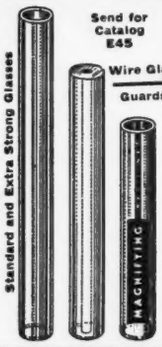
Standard Square Cut Gaskets High Pressure Non-hardening and Non-softening

GASKETS THAT WILL FIT EXACTLY

Red Lip-mold Pattern Expansion Type Gasket

Send for Glass and Gasket Chart

Shipment made by parcel post the same day as order is received



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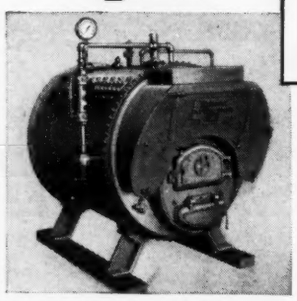
RUBBER & GLASS DIVISION LIVINGSTON, NEW JERSEY

KEWANEE

SCOTTIE JR BOILER

HIGH PRESSURE STEAM AT LOW COST

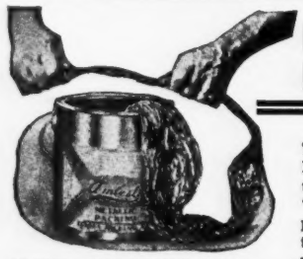


● *5 sizes* . . . conveniently compact yet easily accessible. Economical to buy . . . economical to operate. Easy payments in accordance with U.S. Government regulations thru our Finance Corporation.

For 6" rule with scale for reading pipe sizes, write Dept. 99 K-IV.

KEWANEE BOILER CORPORATION

KEWANEE, ILLINOIS



Put "AMBEST" to a long life test on any tough job

This UNIVERSAL packing—of long, pliable, anti-friction metallic alloy strands—assures low cost, long life packing protection and easy application on any rod in good condition. "AMBEST"—available for all pressures and temperatures up to 550° F.—is recommended for pumps, compressors, engines, throttles and valve stems. *All* needs are supplied by one packing when you use "AMBEST."

PATENTED "EUREKA" TRADE MARK

WRITE FOR WORKING SAMPLE Eureka offers Flax, Asbestos, Rubber and Metallic Packings for all purposes. Send for 36 page catalog.

EUREKA PACKING CO., 294-296 46th St., BROOKLYN, N. Y.

FREDERICK POST CO announces the opening of a new factory branch at 1215 Capitol, Houston, Texas.

POMONA PUMP CO, Pomona, Calif., announces the purchase of the Westco pump division of Micro-Westco, Inc, Bettendorf, Iowa. The newly acquired business will be operated at Pomona Pump Co, Westco Div, at 2621 Locust St, St Louis, Mo., and manufacture continued from the St Louis plant of the Pomona Pump Co. Management and key personnel of Westco will be transferred to St Louis to continue the manufacture and distribution of the line of pumps through the same distributing organization.

SULLIVAN MACHINERY CO announces the appointment of Mr L C Rhodes as manager in the Pacific Coast territory, succeeding the late Perry W Olliver. Mr Rhodes was formerly district manager in Spokane-Butte territory.

CATERPILLAR TRACTOR CO announces personnel changes following the sudden death of Thomas J Conner, vice-president, on Jan 23. Harmon S Eberhard has been elevated to a vice-presidency in the company; C G A Rosen heads a new research department; G E Burks has been promoted to chief engineer; and Charles A Woodley and J R Munroe have been named factory manager of the tractor division and general factory manager, respectively.

OAKITE PRODUCTS, INC, has announced the addition of two new divisions to its field service staff. The New England division, with headquarters in Hartford, Conn., is headed by T R Smith, who will supervise the activities of the eleven men comprising this division. The second new Oakite division is the St. Louis and Southwestern division, making its headquarters in St. Louis. S C Shank has been selected to fill the post of division manager and direct the activities of the men in this division.

YOUNGSTOWN SHEET & TUBE CO has announced the appointment of F D Carroll as district sales manager of their Dallas territory, with headquarters at 610 Continental Building, Dallas, Texas.

HENRY DISSTON & SONS, INC, of Philadelphia, is offering to industry a conservation control plan, designed to save vital material and to speed up production. Based upon construction cards, "conservation control cards," the individual worker is told how to handle a particular tool, how to use it efficiently, how to keep it from breaking, how to

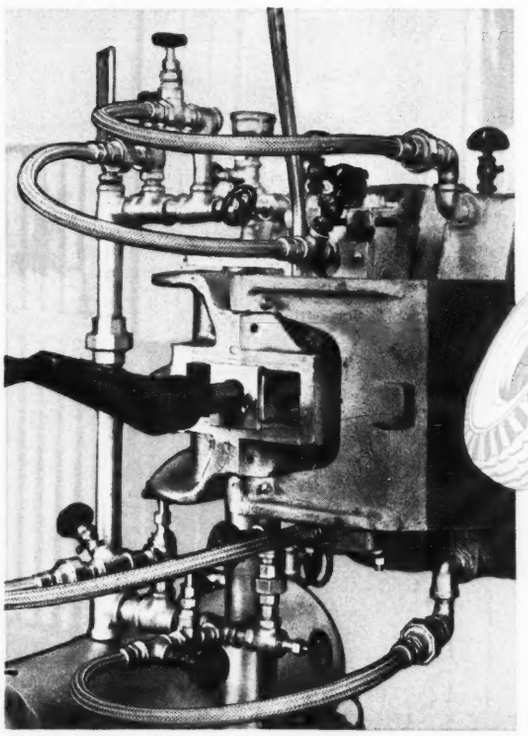
The RIGHT Flexible connector for countless "WAR" applications

IN addition to inherent flexibility, American Flexible Metal Hose and Tubing has that rare quality *flexibility of application* which makes inevitable its use in jobs where less adaptable flexible connectors cannot survive. Plane builders use it to protect aircraft radio sets from low tension static interference; in the form of parachute rip cord housing it guards the lives of our nation's pilots. Insecticides sprayed through flexible metal hose protect growing plants. Tire recapping machines are supplied with live steam.

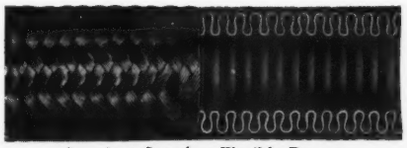
And so it is—wherever moving parts of machinery require connectors to convey steam, water, lubricants; wherever gases, liquids, solvents must be carried safely without leakage, you will find American Flexible Metal Hose.

In thousands of such duties the products of AMERICAN are standing up . . . and speeding up, under twenty-four hour punishment. Whatever or wherever the job — you will find tough, tight, dependable American Metal Hose serving and saving.

SEE ASSEMBLIES ON NEXT PAGE



American Square-Locked Flexible Metal Tubing, cord packed.



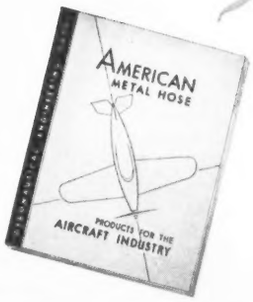
American Seamless Flexible Bronze Tubing.

American Flexible Aluminum Shielding Conduit.

NEW BULLETIN

Contains full data and specifications on American Metal Hose aircraft products—flexible low tension shielding conduit and fittings—flexible aluminum and stainless steel tubing — ferrule attaching machines, etc.

If you are interested send for your copy of Bulletin A-48. For any use of American Flexible Metal Hose and Tubing we shall be glad to supply bulletins which give complete details.



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from mine to consumer

AMERICAN METAL HOSE BRANCH of THE AMERICAN BRASS COMPANY

General Offices: Waterbury, Conn. · · · Subsidiary of Anaconda Copper Mining Company

In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

PLAN *EARLY* FOR *FUTURE* PERFORMANCE

Machine designers . . product engineers . . the best time to plan for the use and benefit of American Metal Hose and Tubing is during the early stages of development.

The assemblies shown above have solved many problems of production, and increased the operating efficiency of products. They have reduced costs, decreased maintenance . . . and provided neat streamlined design. Send for Bulletin A-48 for the Aircraft Industry. Ask us also for specific recommendations or bulletins covering *any* use of American products.

AMERICAN METAL HOSE BRANCH of THE AMERICAN BRASS COMPANY

General Offices: Waterbury, Conn. • *Subsidiary of Anaconda Copper Mining Company*

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Turbine Oil

Why this fact is important to you: You want your turbines to be efficient, dependable sources of power for years to come. The cost of the lubricant to help you maintain this efficiency and dependability is trifling in comparison to your investment —thus you want the highest quality lubricating oil you can obtain.

And that oil is Gulfcrest, for Gulfcrest *alone* is refined by the Alchlor Process, the most effective method yet known for removing undesirable constituents which cause gum and sludge formation. After years of service, Gulfcrest shows so little evidence of deterioration that users report it is in substantially as good condition as when first put into the turbine lubricating system. Gulfcrest is an *entirely different kind* of turbine oil—with an unmatched record of performance.

We suggest that you talk with the Gulf engineer in your vicinity about this remarkable turbine lubricant at your first opportunity. He will be pleased to give you complete details — without obligation.

GULF INDUSTRIAL LUBRICATION

GULF OIL CORPORATION • GULF REFINING COMPANY

GULF BUILDING, PITTSBURGH, PA.

The JONES HEAVY DUTY HAND TACHOMETER

- Simple
- Rugged
- Reliable
- Made in U.S.A.

HERE is a rugged American-built Hand Tachometer . . . available for reasonably prompt delivery, depending on priority rating.

We recommend the Jones Heavy Duty Hand Tachometer for indicating rpm and surface speeds of all types of machinery in which the moving parts are readily accessible.* It is built to "stand the gaff" and maintain good accuracy in every-day hard service. Single and triple range models up to 12,000 rpm.

Write for new descriptive Bulletin 1710-P.

*Where moving parts are not readily accessible, as in turbines, centrifugal pumps and other totally enclosed machines, and also for measuring vibrations per minute, we recommend our Frahm Vibrating-Reed Tachometers. Ask for Bulletin 1590-P.

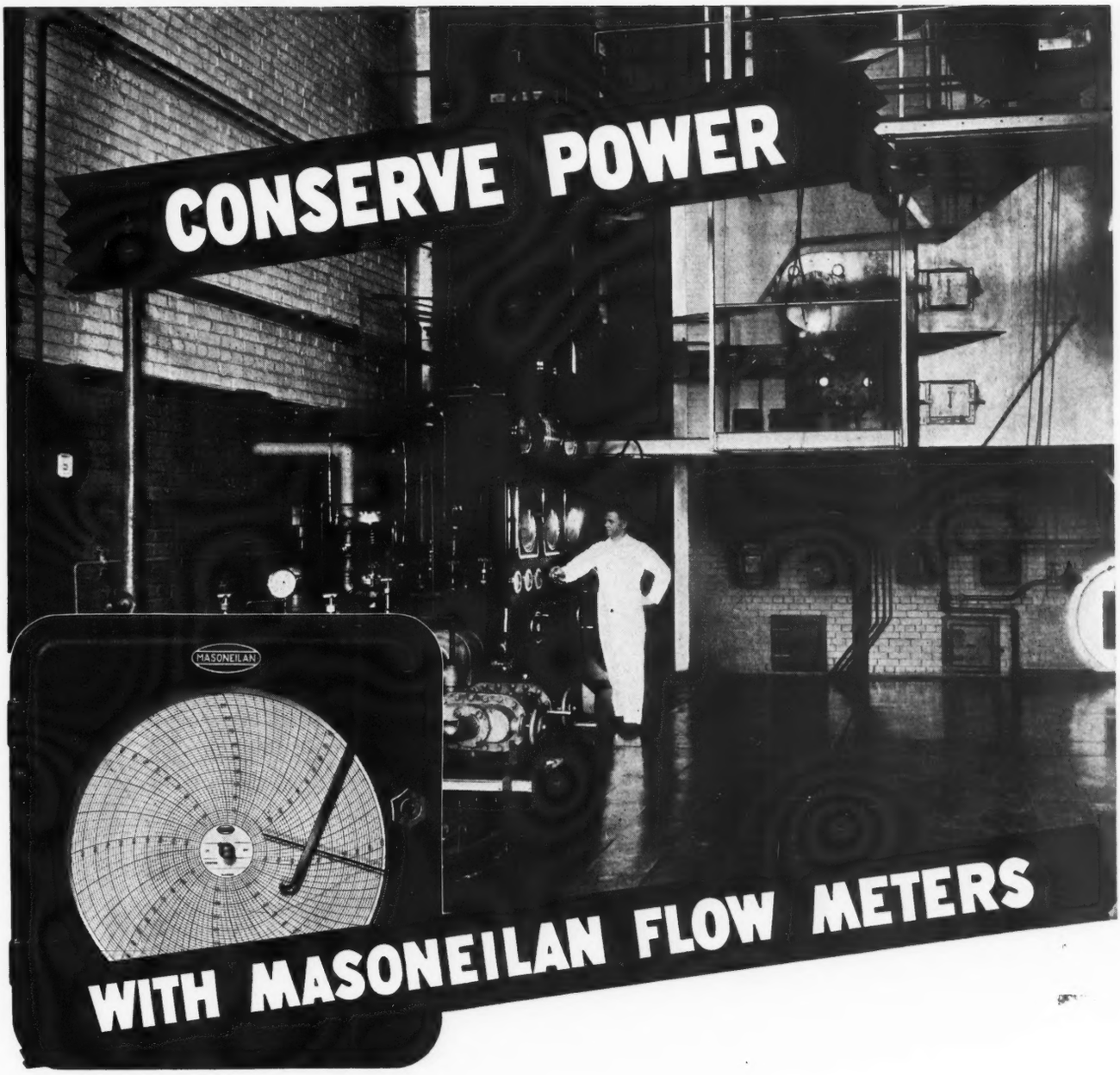
James G. Biddle Co.

1211-13 ARCH STREET *Electrical and Scientific Instruments* PHILADELPHIA, PA.

sharpen it, and other information that will mean easier and better work for him. There are 35 cards, covering cutting tools for metal, wood, plastics, etc. including tool bits, files, hack saw blades, Carboloy knives and cutters, circular metal and wood-cutting saws, hand saws for metal, planer knives, etc. Control cards are supplied free by Disston to any plant, along with buttons bearing its seal and the slogan "Conservation Serves Everyone." Industrial leaders interested in the plan should get in touch with Henry Disston & Sons Co, Philadelphia, Pa.

WATER TREATMENT CO OF AMERICA has announced the appointment of Herbert Kidwell, 407 Randolph St, Charleston, W. Va., as district sales agent for their new water-conditioning system for boilers and condenser cooling systems. Mr Kidwell has been associated with the power field in West Virginia for a considerable period of time.

GENERAL ELECTRIC Co, Schenectady, N. Y., announces personnel information. Raymond T Wagner, 58, sales manager of the Lightning Arrester, Cutout and Capacitor Section of the Central Station Department, died suddenly Feb 11. Mr Wagner joined the company in 1905, and with the exception of a short period during which he was engaged in the public utility business, Mr Wagner was employed continuously by the company. D H Lauder, for the past six years engineer of General Electric's Pittsburgh office, has been appointed assistant to W M Denny, assistant manager of the company's contract service department at Schenectady. Harold M Towne has



POWER saved is power earned—and saving means stopping waste. Measuring steam flow used in various plant operations detects waste quickly, easily, and at a cost so low that often the savings effected more than pay for the flow meters in a matter of weeks.

Masoneilan Flow Meters offer the advantages of sturdy, simple construction; reliability; accuracy; long life and moderate cost. Conserve power for production with Masoneilan Flow Meters.

ESSENTIAL to the ESSENTIAL INDUSTRIES

MASONEILAN
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MASON-NEILAN REGULATOR CO.
1186 ADAMS STREET, BOSTON, MASS., U. S. A.

NEW YORK BUFFALO PHILADELPHIA PITTSBURGH TOLEDO CHICAGO ST. LOUIS HOUSTON ATLANTA
LOS ANGELES SAN FRANCISCO TULSA MASON REGULATOR CO., OF CANADA, LTD., MONTREAL, CANADA

THE Quickest WAY TO GET MORE STEAM FROM YOUR BOILERS

Enco STREAMLINED BAFFLES ARE INDIVIDUALLY DESIGNED FOR EACH BOILER INSTALLATION

RIGHT now, when most power plants are taxed to the limit, the type and construction of the baffle walls in your boilers are of the utmost importance.

That much needed extra capacity, plus lowered operating and maintenance costs can be obtained by the installation of ENCO Streamlined BAFFLE WALLS. We've spent 25 years perfecting baffle wall design and materials to a point where they greatly influence boiler performance.

Write for Bulletin BW-40 or, for quick action, send blue prints and operating data. There is no obligation.

THE ENGINEER COMPANY
75 WEST STREET • NEW YORK, N. Y.

Enco Streamline Baffles
PRODUCED EXCLUSIVELY BY THE ENGINEER COMPANY

been appointed manager of sales for lightning arresters and fuse cutouts, and Max I Alimansky has been made manager of sales for capacitors.

THE ELLIOTT CO, Jeannette, Pa., announces several personnel changes. J E Neiderhauser has been appointed personnel director of the company; J F Brisse has been appointed production manager; H L Dinsmore has been appointed chief industrial engineer, E C Hutchins has been appointed executive engineer of the Ridgway works, C F Baker has been appointed general accountant, and Eugene B Worth has joined the turbine sales department. John H Barnard has joined the turbine department; Charles H Carman, Jr, has been assigned as steel engineer to the Washington office, and Harlan T Hostetter has been assigned to industrial engineering work in the Jeannette plant.

INTERNATIONAL FILTER CO, Chicago, has announced a change in its corporate name to "Infilco Incorporated." The company's early activities were in the design and development of filters and filter plant equipment. Thirty years ago the company began the manufacture of water softeners and other water-conditioning equipment.

CHAIN BELT CO has announced the appointment of Pecaut Industrial Supply Co, Sioux City, Iowa, as distributor of Rex construction machinery in that area.

WICKWIRE SPENCER STEEL CO announced appointment of John A Bigelow as plant protection engineer. Mr Bigelow will supervise protection of the company's seven plants located in Buffalo, N. Y., Worcester, Clinton and Palmer, Mass.; Mt. Wolf, Pa., and Blue Island, Ill.

MANNING, MAXWELL & MOORE, INC, Bridgeport, Conn., announce the appointment of Albert A Haniford to the sales department to extend the program of sales training to company salesmen. Mr Haniford was previously assistant to the director of dealer relations of Johns-Manville. Walter Williams, formerly in the Chicago territory, has been assigned to the St. Louis territory, which was formerly covered by Mr Moore, who has joined the armed forces.

Albert W Mitchell joins the HONAN-CRANE CORP as technical engineer in the sales department. Previous to this appointment, Mr Mitchell was associated with the American Oil Co of Baltimore,

EXACT CONTROL IS *Vital*..

— to maintain consistently uniform quality in the manufacture of Globe Steel Tubes. A large and fully equipped chemical and physical laboratory, manned by graduate metallurgists, is basic to the exact control of production maintained at Globe Steel Tubes Co.

GLOBE TUBES

In addition to the most advanced machinery and methods in the mill, under the direction of a large staff of experienced engineers and technicians, the Globe Steel Tubes Co. laboratory is another important factor which contributes substantially to the inherent quality of Globe Steel Tubes . . . a quality which has won them high recognition with utilities, leading railroads, industrial and marine boiler builders.

GLOBE STEEL TUBES CO.
MILWAUKEE, WISCONSIN

GLOBE STEEL TUBES

STAINLESS TUBES • BOILER TUBES • CONDENSER AND HEAT EXCHANGER TUBES • MECHANICAL TUBING . .

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STOP *the costly loss of live steam*
Keep Steam Units at **TOP** *Efficiency*

Install NICHOLSON Weight-Operated TRAPS

Dependable performance and long life assured by quick snap action . . . non-collapsible float . . . no re-evaporation of condensate under super heat conditions . . . valve always wide open or fully closed. Built for all pressures up to 1500 lbs. Made in sizes from ½" to 2".

Get FREE Handbook of Modern Traps—Write for Catalog No. 941

Contains illustrations of all Nicholson traps, cross sections, mechanical drawings, applications, and complete specifications.

★ ★ ★ W. H. NICHOLSON & CO.

125 OREGON ST., WILKES-BARRE, PA., U. S. A.

Piston and Weight Operated Steam Traps, Industrial Thermostatic Traps, Compressed Air Traps, Gasoline Traps, Steel and Stainless Steel Floats, Flexible Couplings, 2- 3- and 4-way Valves, Compression Shaft Couplings, Expanding Mandrels, Arbor Presses, Steam Eliminators and Separators.

• More grate area with low combustion rate per square foot of area! . . . Frederick Stokers have specially designed tuyeres with air ports so arranged and proportioned as to insure correct air distribution and maximum efficiency in combustion. Enclosed wind-boxes with two clean-out doors, another exclusive Frederick feature, eliminate possible air leakage through brickwork. . . .

FULL ACTIVE GRATE SURFACE

without dead plates!

YES, NEW FREDERICK STOKERS *ARE* DIFFERENT. A long list of original features distinguish them; many common stoker problems are solved by them. We suggest you write for complete description. Just send a note on your letterhead to

THE FREDERICK IRON & STEEL CO.
Frederick, Md.

Side dumping grate type burner.

Frederick INDUSTRIAL **STOKERS**

COMPLETE LINE OF CENTRIFUGAL PUMPS FOR ALL PURPOSES
STEAM OPERATED ASH CONVEYING SYSTEMS • ASH STORAGE BINS

with whom he had been associated since early in 1938.

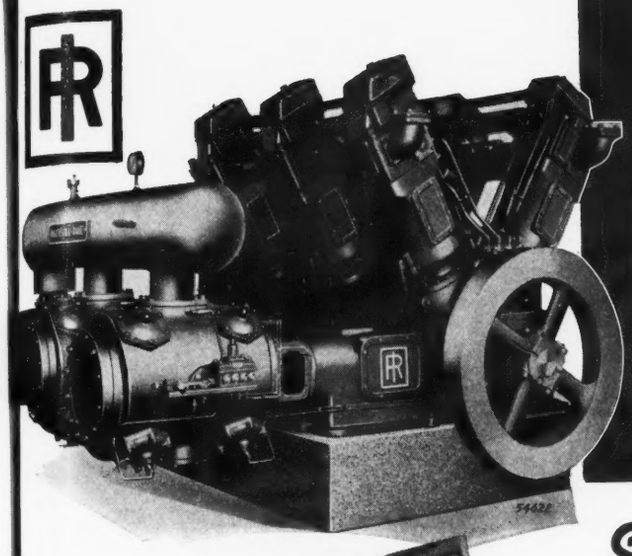
BITUMINOUS COAL RESEARCH, INC, announces the addition of two fuel engineers to its staff. They are Howard A Herder of the Sahara Coal Co, Chicago, and Vernon G Leach, of the Peabody Coal Co, also Chicago. As members of the Technical Advisory Board, Messrs Leach and Herder will be engaged in adapting bituminous coals to combustion equipment and facilities in both industrial and domestic heating applications. With the 22 other fuel engineers in the group, they will review progress reports and consider new research projects that will advance the use of coal.

THE SAWYER ELECTRICAL MFG CO, Los Angeles, Calif., announces the appointment of George M Snodgrass as manager of its eastern sales division, headquarters for which will be at 2110 Terminal Tower, Cleveland, Ohio. Before his recent appointment as Sawyer division manager, Snodgrass was vice president and sales manager of the Imperial Electric Co, Akron. Prior to that he had been sales manager in the electrical division of Fairbanks, Morse & Co.

Organize Fluorescent Lighting Association

Primarily as a wartime measure to provide maximum illumination from a minimum of materials, particularly as regards metals and other items subject to rigid priorities and restrictions, leading manufacturers of fluorescent tubing and components have organized the Fluorescent Lighting Association with headquarters at 509 Fifth Avenue, New York. In addition to the conservation program for wartime needs, the Association proposes to make more widely known and available the remarkable flexibility and economy of cold-cathode continuous-tube lighting (the latest development in fluorescent illumination) for general industrial, commercial, office and other usage. Because of its extremely long life, reliability and complete freedom from starting gadgets, combined with its large surface area and relatively low glare, this form of fluorescent illumination has already been recognized as filling a real need where these qualities are required.

The Fluorescent Lighting Association has lost no time swinging into action. Already its Committee on Standards has inaugurated comparative tests and studies aimed at standardizing the more



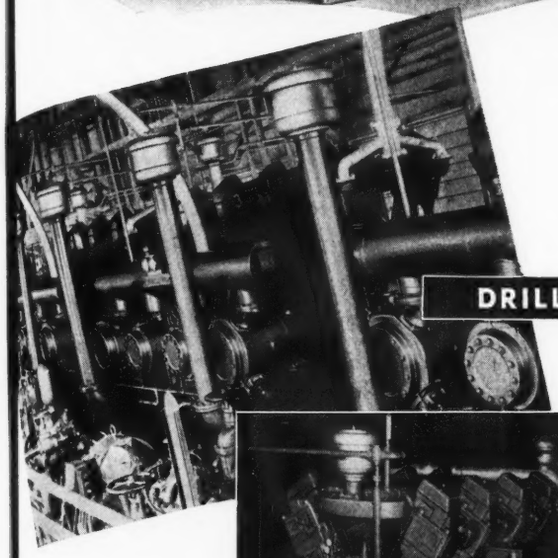
Type XVO DIESEL-POWERED COMPRESSORS

Save Thousands of Dollars on Jobs Like These

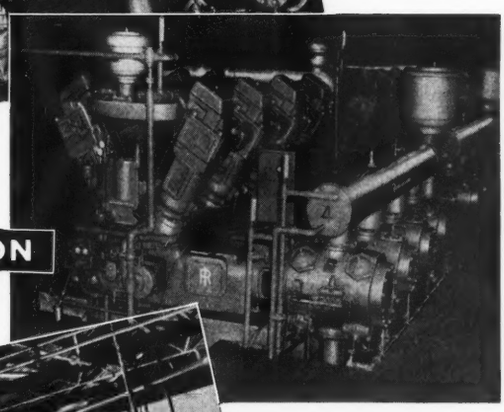
With one gallon of fuel the XVO will compress 5600 cubic feet of air to 100 pounds pressure. That is 933 cubic feet for 1¢ when fuel costs 6¢ per gallon.

Such exceptionally low fuel costs reflect the advanced engineering features that have been built into this compact 4-cycle Diesel engine and the modern air compressor.

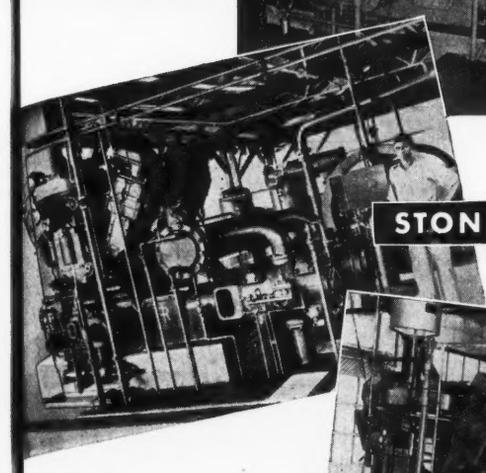
The proved reliability and ease of operation make the unit ideal for a wide variety of jobs. Owners everywhere tell us that it fulfills a long-felt need for a modern direct-connected Diesel engine driven compressor. Ask our nearest representative for further information, and for catalog 3072.



DRILL BOAT

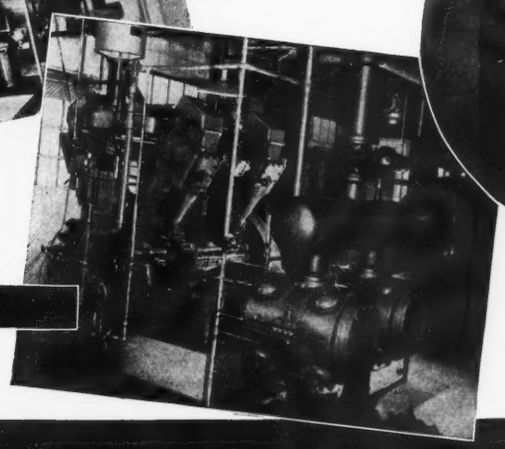


CONSTRUCTION

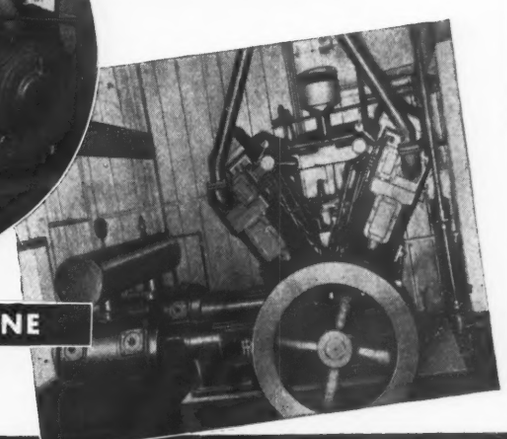


STONE QUARRY

ROAD BUILDING



FACTORY



SILVER MINE

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6-134

popular fluorescent colors, starting with the so-called 3500 white. The present discrepancies in shade between different manufacturers' white tubes bearing this designation is soon to give way to a definite color and shade critically maintained by tube makers whose products carry the Association's seal of approval.

Also, the Association now has under way the compilation of a manual on cold-cathode continuous-tube illumination as distinguished from the commonplace hot-cathode-fluorescent lamps. Standard specifications are to be made available to property owners, architects, engineers, industrial plants and other potential users, as well as to tube makers, whereby to assure satisfactory installations based on tried and proven practices. A steady flow of informational data is to be released to the technical and trade press, while the Association serves as a clearing house of practical information on this most modern illumination means.

Close contact is being maintained with Government officials and bureaus charged with conserving and releasing materials, whereby the minimized needs of cold-cathode continuous-tube illumination may be fully appreciated and exploited as a definite wartime economy.

The Association will soon have exhibition installations available in various metropolitan centers, in demonstrating the advantages of cold-cathode continuous-tube fluorescent illuminations, and also as models for architects and lighting contractors to go by.

Air-Cooled Transformers Enter New Fields

Air-cooled, fire-proof transformers with class B insulation first appeared about five years ago, in sizes from 150 to 500 kva. The development was immediately popular because of the great need for transformers that are fire- and explosion-proof and that require no special vault construction to meet fire-insurance regulations. This type of transformer is entering new fields. Two are particularly interesting. One is underground, as in coal mines. In one West Virginia installation a Westinghouse 165-kva, 2300-volt, 3-phase air-cooled transformer is replacing three single-phase oil-cooled units. A similar unit is being used 950 feet underground in a metal mine in Wyoming, as an integral part of a 300-kw ignitron-rectifier substation.

The air-cooled transformer is almost ideal for underground work because it eliminates hazards of fire and explosion of such concern in mines. In addition,

TIME, BRAIN AND MUSCLE SAVERS

Now if ever is the time to install equipment that will speed production, relieve your designers and save man-power.

Gifford-Wood installations are handling air and lifeboats; toy soldiers and steel cabinets; loaded shells and machine parts; bulk materials, and packaged goods.

Gifford-Wood advantages include 126 years of specialized experience; undivided responsibility for design, construction and installation; and a professional approach that holds no brief for any given kind of equipment except that which will do the job in the best way.

Data Book No. 200-1 contains 124 pages of ideas that show how to combine special and standard designs for economy.

GIFFORD-WOOD CO.
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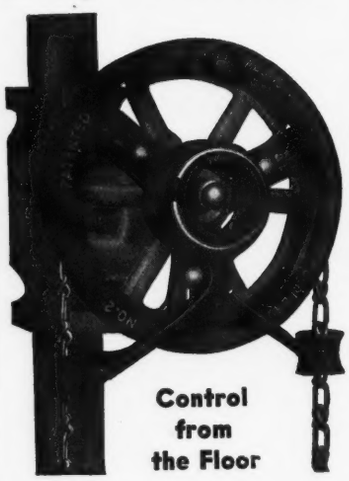
Make Your Overhead Valves SAFE And Easy to Reach---



With the Babbitt Rim for Valves you eliminate danger and banish the step ladder. You can now place your valves wherever they come economically and conveniently. They fit any valve. Let us tell you more about them. Write today.

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New Bedford, Mass.

BATESGRATES
FILLET WELD
Open Steel Floor Grating

Easily maintained - - -
NO CRACKS, JOINTS, CREVICES

Batesgrates are self-cleaning because of peaked, non-skid cross bar. They have no grooves or rough burned metal to catch grease or dirt. Safe traction. Batesgrates are strictly one piece—no cuts, slots, or punching. Made from Hexagon Shaped Hot Rolled Steel Bars with smoother, larger, much stronger welds. Send today for engineering Catalog No. 937.

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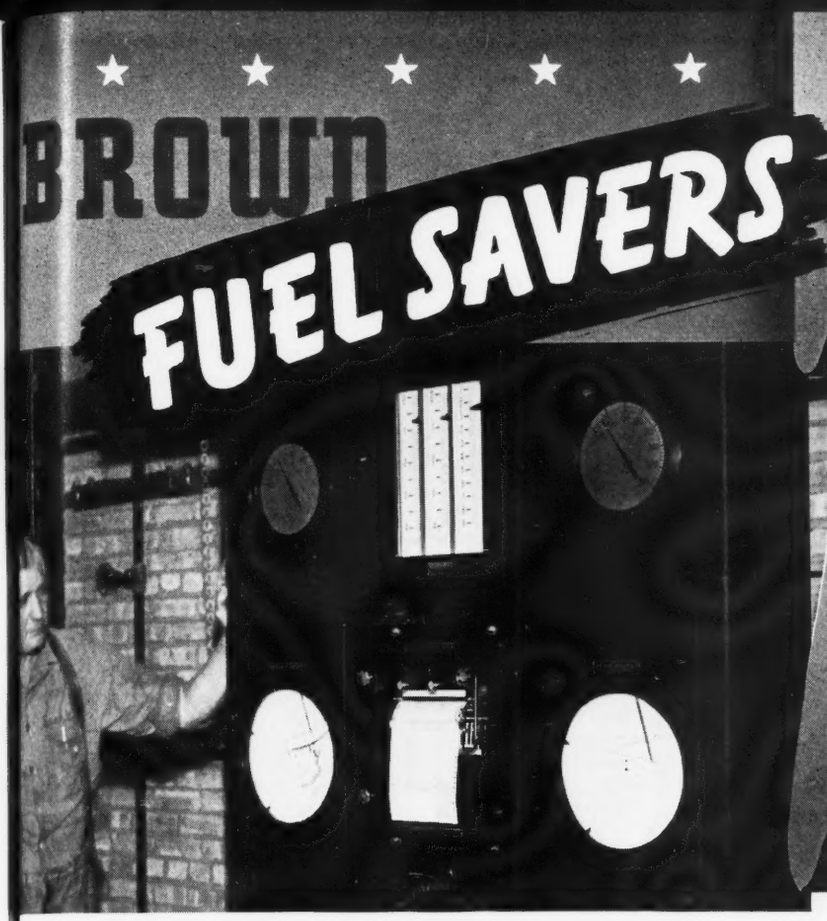
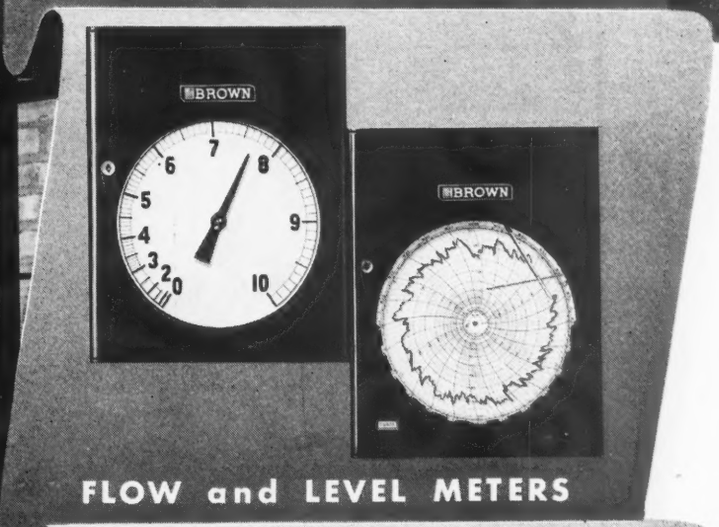
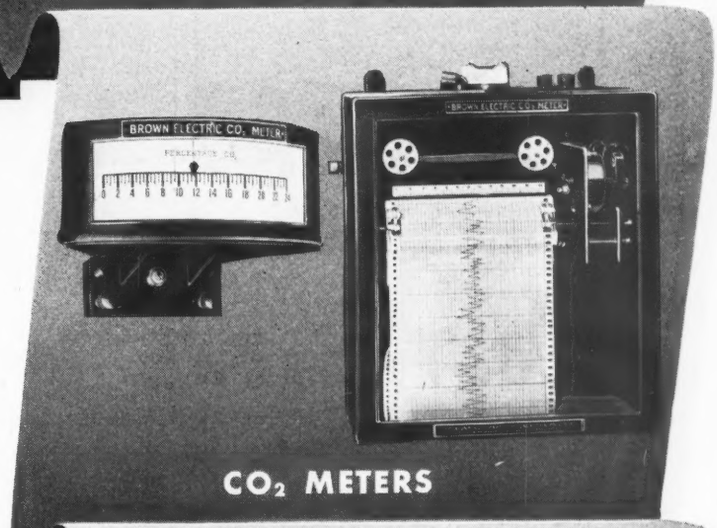
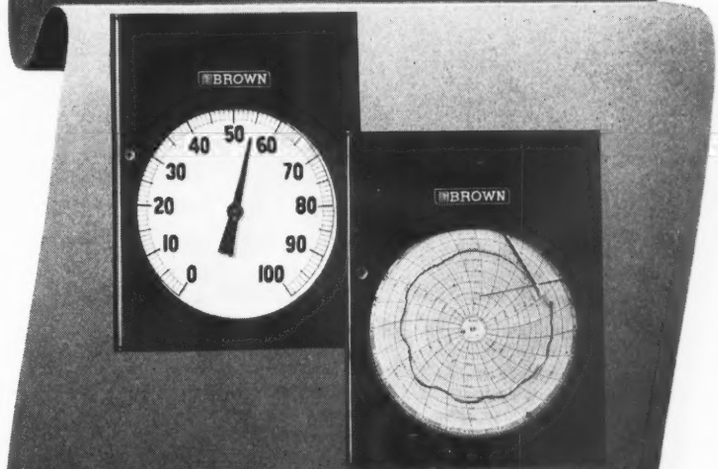




FLOW and LEVEL METERS



CO_2 METERS



TEMPERATURE & PRESSURE GAUGES

IF you use steam for power, heating or processing—do you know how much steam is generated for every dollar expended for fuel? Are your boilers operating at their highest efficiency? How economically is steam being used?

To get the answers to these questions it is essential to measure temperatures, pressures, flows, $\%CO_2$ and liquid levels.

Whether you burn oil, gas or coal, Brown Indicating and Recording Instruments furnish the essential information to operators and engineers to enable them to reduce fuel costs. For example:

BROWN FLOW METERS . . . tell how much steam is generated by each boiler; the amount of water fed to the boilers, and the rate and quantity of blow-down.

BROWN CO_2 METERS . . . when used as a firing guide, enable operators to hold the correct per cent CO_2 and prevent fuel losses due to improper air-fuel ratios.

BROWN THERMOMETERS AND PYROMETERS . . . are essential guides in checking Flue Gas, Feed Water, Economizer and Superheater temperatures. They are vital factors in overall operating efficiency.

BROWN PRESSURE GAUGES . . . aid in maintaining steam pressures, not only in the boiler, but also in each department.

Our engineers will be glad to recommend the instruments that will most economically meet your boiler room or plant requirements. Write for information.

ELECTRIC • AIR OPERATED

For Temperatures . . . . . Pressures . . . . . Flows . . . . . Liquid Levels

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THE BROWN INSTRUMENT COMPANY, 4490 WAYNE AVENUE, PHILADELPHIA, PENNSYLVANIA

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LONG LIFE BOILER FURNACE LININGS WILL CUT YOUR OPERATING COSTS

ADAMANT
FIRE BRICK CEMENT

ADAMANT has a P.C.E. of over 3000° F.

High BONDING STRENGTH (proved by impartial laboratory tests)

800 lbs. per sq. in. at room temperature—1270 lbs. per sq. in. at 2600°F.

Makes the joints as Strong as the Bricks they bond!

Resultant Longer Life of Boiler Furnace Linings means savings in time, materials and money.

Adamant comes ready-mixed and is so easy to use. Write for the facts today.

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NEW! A TOUGH FLOOR PATCH

. . . That's Ready for Traffic in 1 Minute

Repair rough, broken Factory Floors speedily for instant traffic use. Ready mixed INSTANT-USE Resurfacer makes a quick—good solid job. Simply shovel into hole and tamp. Run traffic over patch immediately. NO WAITING! Bonds tight to concrete or wood. Used, too, for complete overlay.

MAKE THIS TEST!

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2377 Manning St., Phila., Pa.

Tell us about INSTANT-USE RESURFACER over concrete or wood, and details of FREE TRIAL OFFER. No obligation.

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the light weight and small dimensions of the unit make it particularly desirable for handling underground, where clearances are small and facilities for handling heavy objects are limited.

A particularly severe test of this air-cooled transformer idea was afforded in a potash plant. A unit was installed in such a plant in New Mexico in the fall of 1940. Although it is located in an atmosphere laden with rock-salt dust, the only servicing that has been required is a periodic blowing out.

Small Transformers

A logical extension of the air-cooled, fire-proof insulation idea is to smaller distribution transformers and to small power transformers. These have been air cooled before, but never used the class B insulation that renders them fire proof. This removes the serious restrictions on their location inside buildings. As they do not require special vaults or barriers, they can be located in any convenient corner, or on light-weight balconies close to the lighting circuits or other equipment they supply, with resulting better voltage regulation. These units are now being built in capacities up to 3000 kva and up to 15000 volts.

With the defense program requiring new factories and extensions to old ones extensive use has been made of the secondary-network system, ideally suited for supplying power that must not be interrupted, either by accident or by malicious intent. Just in time to be of great assistance in this program is the appearance of a completely air-cooled network unit, that includes the transformer, high-voltage switch and low-

HELP DEFENSE STOP ACCIDENTS

RUNNING IN THE PLANT SLOWS UP SAFETY

NATIONAL SAFETY COUNCIL

For EFFICIENT OPERATION you must ACCURATELY determine the phosphates in your boiler water!

AMONG the hazards of poorly conditioned boiler water are corrosion, pitting and intercrystalline cracking. The famous Taylor Boiler Water Slide Comparator will save you dollars every day . . . help you cut down on boiler repairs and costly descaling shutdowns. Simplicity of determination, accuracy, speed and low cost are features that have made Taylor pH Slide Comparators standard equipment in prominent industrial plants.

Write today for new 80-page booklet, "Modern pH and Chlorine Control," or see your dealer.

All Taylor Color Standards carry an unlimited guarantee against fading.

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YORK & ROGERS FORGE RDS. • BALTO, MD.

THE THERMOMETER with the 3 R's

Ruggedness . . simple all-metal construction withstands mechanical abuse around the active plant . . resists damage from vibration or over-ranging.

Readability . . large dial-type scales insure quick, accurate readings whether mounted on overhead lines or on equipment in hard-to-get-at places.

Reliability . . with nothing to leak or wear, WESTON all-metal thermometers maintain their high accuracy far longer.

Complete information on WESTON all-metal Thermometers, including types, sizes, ranges, etc., gladly sent on request. Weston Electrical Instrument Corporation, 679 Frelinghuysen Ave., Newark, N.J.

WESTON ALL-METAL TEMPERATURE GAUGES

Looking ahead with Asbestos

HE who predicts a lusty future for K&M "Featherweight" 85% Magnesia is playing safe, indeed.

In any "Tomorrow" visible from here, this great insulating material is bound to click. For many of the Nation's leading industries have already proved it to be as efficient an insulator up to 600°F. as they've been able to find. Proved *and* attested! A fuel and heat conserver of unmatched thriftiness.

And not only thrifty but tough! Two years spent in a sunken ship did not impair its efficiency; nor could the Ohio River's muddy floods do it any harm.

When the demands of war relax and K&M "Featherweight" 85% Magnesia gets its honorable discharge, who can doubt that it will continue to get a tremendous peace-time play?

Meanwhile, a pledge and an invitation: We shall continue our researches in asbestos, seeking new uses for this gifted mineral; you in turn are urged to offer suggestions that might lead to asbestos helping you more.

* * *

Nature made asbestos;
Keasbey & Mattison, America's asbestos pioneer,
has made it serve mankind . . . since 1873.

KEASBEY & MATTISON
COMPANY, AMBLER, PENNSYLVANIA

Makers of

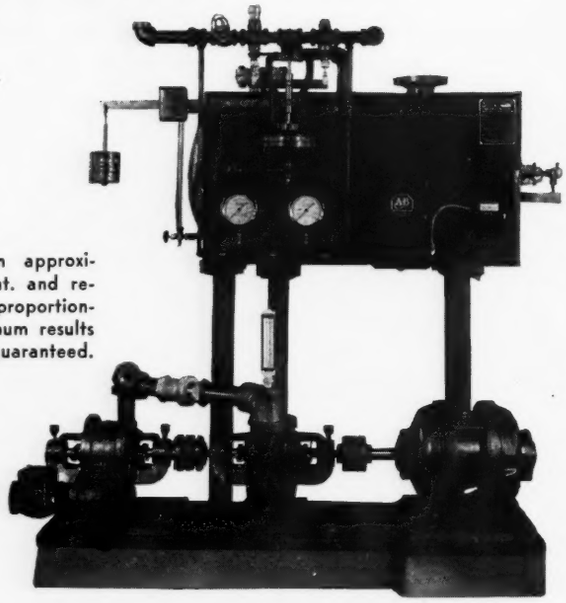
asbestos-cement shingles and wallboards; asbestos and magnesia insulations for pipes, boilers, furnaces; asbestos textiles; asbestos electrical materials; asbestos paper and millboard; asbestos marine insulations; asbestos acoustical materials; asbestos packings; asbestos corrugated sheathing and flat lumbers; asbestos-cement pipe for water mains

INCREASE BOILER CAPACITY AND SAVE FUEL

STICKLE DIFFERENTIAL DRAINAGE & BOILER RETURN SYSTEM

increases boiler capacity an approximate average of 20 per cent. and reduces consumption of fuel proportionately. No guesswork. Minimum results calculated in advance and guaranteed.

MAKES YOUR PRODUCTION PROBLEM EASIER



• This Stickle closed pumping system returns condensate from processing units to boilers at temperature only 15 to 20 deg. below steam temperature at operating pressure. Example: Condensate of steam at 125 lbs. pressure is returned to boilers at approximately 330 deg. as compared with 210 deg. with open vented system. Any plant using 40 to 200 deg. process steam pressures can obtain fuel savings of 15 per cent. or more, and increase boiler capacity in the same ratio as fuel savings. Additional advantages: Improved operating efficiency for processing units, elimination of hot water overflow and flash steam wastes, steam trap troubles obviated, pumping costs reduced by half, and reduced maintenance of boiler and steam lines. *Ask for Bulletin No. 50.*

BETTER DRAINAGE WITH STICKLE STEAM TRAPS

• Stickle Steam Traps are open float construction combined with internal by-pass for air. Known for dependability, long life and low upkeep. No levers or hinges. Trap illustrated, Stickle 100 Series, for medium and high pressures, built for straight-in-line installation. Ideal for draining small industrial processing equipment, unit heaters, etc. *Ask for Bulletin No. 115.*

Steam Equipment TO INCREASE PRODUCTION AND SPEED VICTORY

SEND FOR BULLETINS

REGULATING VALVES: Stickle Series 200, a complete line of self-contained and pilot-operated valves. Small to large pipe sizes. Applicable to wide field of service. Meet requirements of complicated pressure regulation. *Ask for Bulletin No. 235.*

REGULATING VALVES: Stickle Series 400. Single-seated reducing valves for regulation of medium and high pressure steam and for controlling high temperature liquids, etc. *Ask for Bulletin No. 435.*

STEAM TRAPS: Stickle AE Series for high and medium pressures. Seven sizes representing capacity range of 5,000 lbs. to 27,000 lbs. per hour. *Ask for Bulletin No. 315.*

STEAM TRAPS: Stickle Series T specifically designed for draining equipment operating with low pressure steam or for vacuum service. 12 sizes. Capacity range, 200 lbs. to 10,000 lbs. per hour. *Ask for Bulletin No. 415.*

OIL AND STEAM SEPARATORS: Built to obtain definite guaranteed results. 14 sizes. *Ask for Bulletin No. 20.*

FEED WATER HEATERS AND PURIFIERS: Open coil. Large tray surface. Cast iron or steel. Deaerating or Non-Deaerating. Guaranteed to heat water to higher temperature in less space. *Ask for Bulletin No. 100.*

STICKLE

STEAM SPECIALTIES COMPANY

2265 Valley Avenue, Indianapolis, Indiana

SPECIALIZING FOR 35 YEARS IN REDUCING THE COST OF STEAM

voltage protector. It can be installed any place indoors without requiring further enclosing structures.

Installed in Ohio are three 2000-kva. 4600-volt tap-changing transformers for a metropolitan area. They are completely air-cooled, even including the tap-changing switches. These are the largest air-cooled transformers built with the fire-proof insulation. Also they are the first of this type to use forced-air cooling and the first air-cooled transformers for tap changing under load. Nine fans in the base blow air upward through the coils. The fans can be controlled automatically in accordance with the load; the units can carry 150 load with the fans in operations.

Welding Film Premiere

Industrial training for defense was the chief subject of discussion at the testimonial dinner for James F Lincoln, president of the Lincoln Electric Company of Cleveland, at the Biltmore hotel, Los Angeles, recently.

The main feature of the program was the premiere screening of one of the first motion pictures designed to speed up defense training for industry, and increase the country's pool of skilled manpower.

This picture, "Inside of Arc Welding," produced by Raphael G Wolff of Hollywood, is a color instruction film illustrating the technique of arc control and electrode manipulation and showing the various steps in the welding

Joe McGee, new movie cartoon creation of Raphael G Wolff of Hollywood, welcomed guests at the testimonial dinner for James F Lincoln, president of the Lincoln Electric Company with a big smile and a big "V". McGee made his public debut in "Inside of Arc Welding".

BETTER PRINTS FASTER WITH DRY DEVELOPMENT

BASIC FACTS ABOUT PRINT MAKING YOU SHOULD KNOW

OZALID SENSITIZED MATERIALS ARE AVAILABLE IN CUT SHEETS AS WELL AS ROLL STOCK. Thus, when you have engineering drawings, maps or charts to be reproduced, you can eliminate trimming waste by using cut sheets of Ozalid material which correspond to the size of your tracings.

Ozalid cut sheets are conveyed through an Ozalid whiteprint machine the same as roll stock—without "leaders" —without the complex operations necessary with all wet development processes. By contrast, blue print material when cut from a roll must be processed by hand.

This is the fourth of a series of facts on modern printmaking. Watch for Fact No. 5.

PRINTS DEVELOPED DRY are permanent — true-to-scale of the original — made so quickly you're able to speed your entire production schedule!

The Ozalid Process of making positive-type whiteprints by dry developing sensitized materials in a whiteprint machine is simplified printmaking that will give you ***better*** prints ***faster!***

Ozalid whiteprints are made in two fast operations — exposure and dry development. They are never moistened by solutions—never washed or fixed as in blue printing—never wrinkle—curl—or fade in sunlight.

Standard Ozalid sensitized materials develop blue, black, or maroon lines on a white background. Transparent papers, cloth or foils produce duplicate originals which are three to five times faster printing than Van Dykes when making subsequent prints.

Whether you need large — small — or medium print production, there's a specific Ozalid machine to meet your demands—to enable you to speed production. By dry developing your prints you save in time — labor — materials.

Write today for an illustrated folder describing the many advantages of printmaking with the Ozalid Process.

SPECIFY *Ozalid* WHITEPRINTS

OZALID PRODUCTS DIVISION
GENERAL ANILINE & FILM CORPORATION
JOHNSON CITY, N.Y.
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JOHNSON *Jeweled Movement* CONTROL

Helping to Build Precise War Machinery

IN war production plants, Johnson equipment automatically regulates temperatures and humidities in work spaces, test rooms, and processing chambers. That is the wartime role of Johnson "Precision-Planned Control". Aircraft parts are machined and assembled, powder is manufactured, and shells are loaded in buildings where heating, ventilating, and air conditioning apparatus is "watched", accurately and efficiently, by complete systems of this tried-and-tested control equipment.

Johnson *Jeweled Movement* Control means that critical moving parts in thermostats and humidostats have hardened steel pivots operating against precious stones. No binding! No wear! Smooth, g-r-a-d-u-a-l operation. Just one more example of the care and precision that characterizes modern Johnson control.

The nation-wide Johnson organization solves industry's temperature and humidity control problems. Ask for bulletins describing smooth-operating jeweled movement instruments and other Johnson controllers. Or, call a Johnson engineer from a nearby branch office. There is no obligation, of course.

JOHNSON
Automatic TEMPERATURE AND AIR CONDITIONING *Control*
JOHNSON SERVICE COMPANY, MILWAUKEE, WIS. & BRANCHES IN PRINCIPAL CITIES

process. It marks the first step in the application of visual education methods to welding instruction.

Mr Lincoln cooperated in the making of the film which has been more than six months in preparation and will be released immediately to schools and training groups. "Inside of Arc Welding" combines animated cartoons with actual photography to show the complete welding process on the screen.

Dr F E Giesecke Gets Paul Anderson Medal

Dr Frederick Ernst Giesecke, Professor Emeritus, Heating, Ventilating and Air Conditioning, at A & M College of Texas, College Station, Texas, received the F Paul Anderson Gold Medal awarded by the American Society of Heating and Ventilating Engineers for distinguished scientific achievement. The presentation was made by Thornton Lewis of Newtown, Pa., donor of the medal, at the 48th Annual Meeting of the Society held in The Bellevue-Stratford Hotel, Philadelphia, January 28, 1942.

The Committee on Award honored Dr Giesecke for his notable contributions to the advancement of heating based on his research work in the fields of heat transfer and hot water heating, and for his eminent services to the Society as a member and officer.

Dr Giesecke was born in Washington County, Texas, in 1869 and, after receiving his preparatory education in the New Braunfels and San Antonio schools, attended the Agricultural and Mechanical College of Texas, where he was graduated in 1890. In 1906 and 1907 he studied abroad under Dr H Rietschel and subsequently he received degrees from the Massachusetts Institute of Technology and the University of Illinois.

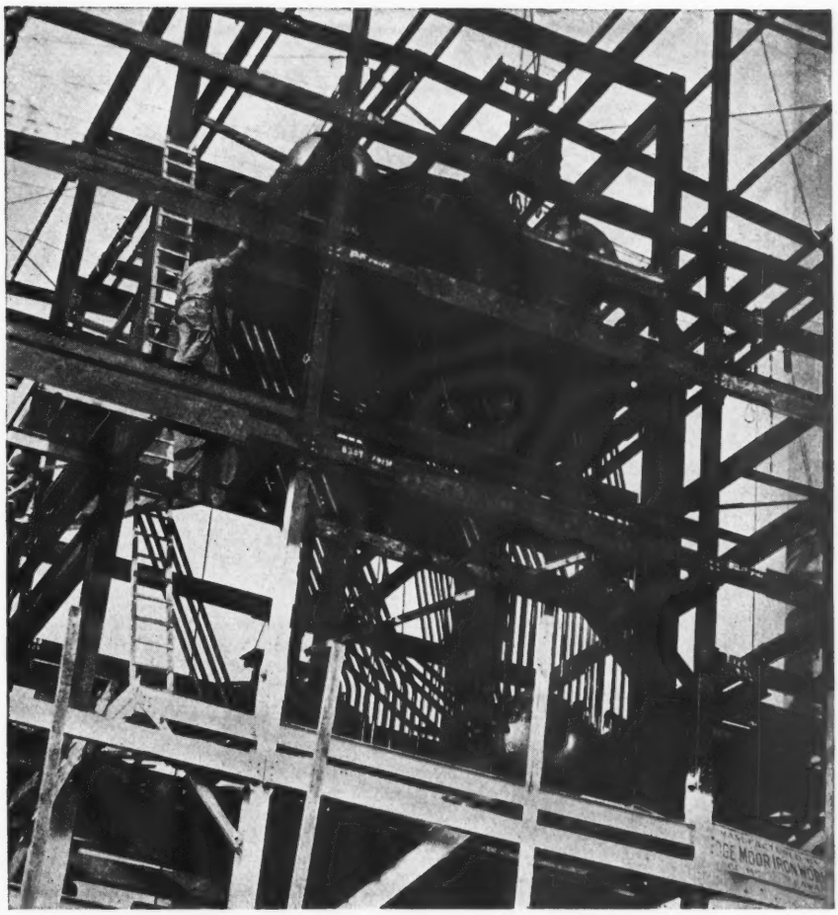
Dr Giesecke commenced his teaching career at A & M College of Texas in 1886, where he taught until 1912, after which he became Professor of Architecture at the University of Texas, Austin, as well as consulting architect, specializing in heating and ventilating. In 1927 he assumed the directorship of the Engineering Experiment Station at A & M College of Texas, a position he held until his retirement in 1939.

In 1940 he was President of the American Society of Heating and Ventilating Engineers, and also been first vice president and second vice president, as well as serving on innumerable Technical Committees.

He is the author of several technical books including, "The Design of Grav-

This EDGE MOOR *for*

750 lbs. pressure can be duplicated promptly . . . . .



This installation—designed, built and erected entirely by EDGE MOOR—is typical of the advanced engineering, modern practice and complete service available through this organization of steam generation specialists.

This boiler, which is now in operation, can be duplicated promptly because all designs and installation details are available making it possible to save the time which ordinarily is required for preliminary engineering in developing new designs.

Other boilers, previously designed and erected by EDGE MOOR can also be reproduced in shortest possible time.

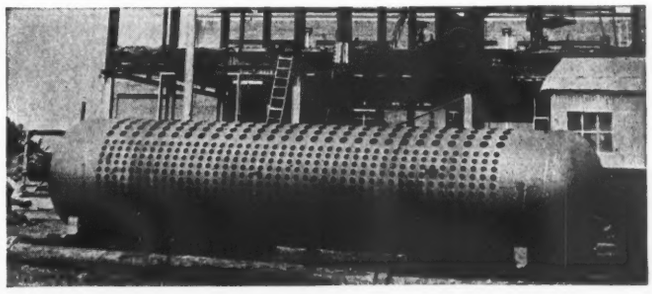
By consulting EDGE MOOR for complete steam generating units, you can be assured of coordinated engineering and centralized responsibility in meeting your requirements. We invite your engineers or your consulting engineers to submit your specifications for an EDGE MOOR proposal.

Above: EDGE MOOR Bent Tube Boiler (capacity 150,000 pounds of steam per hour) being installed for 727 lbs. pressure, superheated to a total temperature of 750° F.

Superheater, economizer and water cooled walls are of EDGE MOOR design and construction.

●

Below: The drum for the above boiler is of 2⅜" boiler plate, Welded, Annealed and X-rayed.



COMPLETE BOILER PLANTS
including
BOILERS
SUPERHEATERS
STOKERS
WATER WALLS
ECONOMIZERS
AIR PREHEATERS

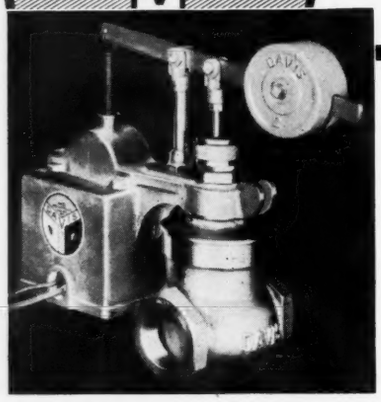
EDGE MOOR IRON WORKS, INC. 30 Rockefeller Plaza, New York, N. Y.

Kansas City Chicago Detroit Richmond, Va.

In Canada UNITED STEEL CORPORATION, LTD. Toronto Montreal

Industrial Type

SOLENOID VALVES



No. 93 is a simple general purpose valve.

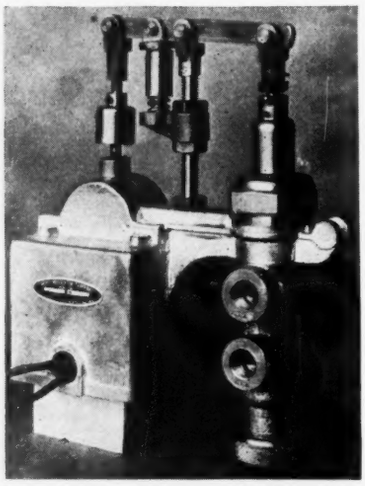
1. QUALITY CONSTRUCTION. Every Davis Solenoid Valve is specifically designed and built to stand up under heavy duty industrial service.

2. COMPLETE LINE. 14 different standard types and dozens of special designs. Sizes ranging from ½" to 12". For pressures to 1500 lbs. per sq. in., or higher.

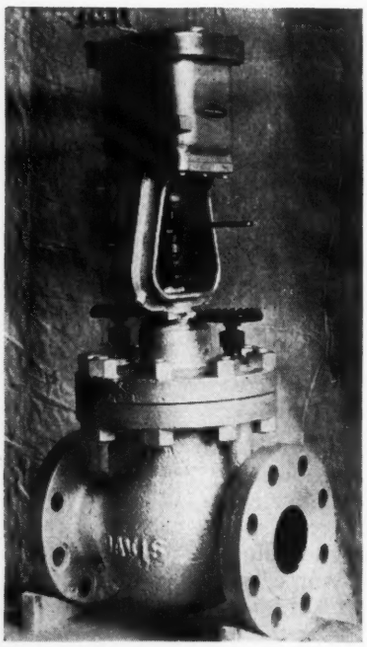
3. EXCLUSIVE FEATURES. Davis' special design features include: semi-self cleaning valves for handling heavy viscous materials, patented throttling action for container filling service, leakproof valve heads for volatile materials, etc.

We will be glad to make recommendations on your particular requirements. Ask for a copy of the Davis Solenoid Valve Catalog.

DAVIS REGULATOR CO.
2540 S. Washtenaw Ave.
Chicago Illinois

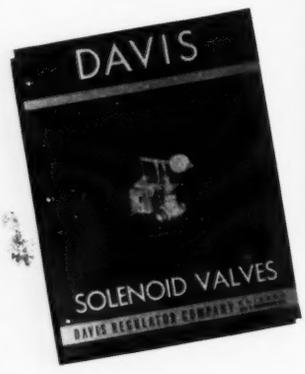


No. 380 is a 3 or 4-way pilot valve widely used on air or liquid actuated power cylinders.



Above is shown a No. 93 H unit with solenoid operated pilot valve and hydraulically actuated main valve built for use on a 400 lb. pressure water main.

ASK FOR A COPY OF THIS BULLETIN:



DAVIS REGULATOR COMPANY

ity-Circulation Water Heating Systems," published in 1926, and the joint author with A Mitchell and H C Spencer of "Technical Drawing and Technical Drawing Problems," widely used in colleges, and other technical books and papers.

The F Paul Anderson Medal Committee on Award for 1941 consisted of Professor E O Eastwood, Seattle, Wash.; D S Boyden, Shirley, Mass.; W T Jones, Boston, Mass.; E Holt Gurney, Toronto, Canada, and Professor Perry West, Lexington, Ky. This award was created in 1931 by Thornton Lewis in honor of the late F Paul Anderson, past president of the American Society of Heating and Ventilating Engineers, former director of its Research Laboratory and former Dean of the College of Engineering, University of Kentucky, Lexington, Ky.

Practical Power Papers in Conference Program

Many practical power papers are scheduled for presentation at the Mid-West Power Conference, April 9 and 10, Palmer House, Chicago. Sessions will cover the war emergency, central station practice, electric power transmission, lighting, industrial power, hydro power, boilers and stokers, diesels.

Willard Chevalier, vice president of the McGraw-Hill Publishing Co, will speak at the "all-engineers dinner," April 9. Toastmaster will be Wm F Sims, chief electrical engineer, Commonwealth Edison Co. President H T Heald of Illinois Institute of Technology, Dean A A Potter of Purdue and Chairman Leland Olds of the Federal Power Commission, will address the opening session. Olds will discuss "Power and the War Effort."

Papers of particular interest will include the following: "Prevention of Steam Losses and Fuel Waste in the Present Emergency" by V G Leach, Peabody Coal Co; "Controlled Forced Circulation Boiler at Somerset Station" by F H Rosencrants, Combustion Engineering Co; "Maximum Output from Existing Boiler Plants" by E G Bailey, Babcock & Wilcox Co; "Power in the Flour Milling Industry" by A R Ulstrom, Cerial Engineering and Construction Co; "Feedwater Treatment in Small Power Plants" by Everett P Partridge, Hall Laboratories, Inc; "Power Recovery Installation" by C A Chayne, Buick Motor Division; "Silting of Water Power Reservoir" by Prof E W Lane, State University of Iowa.

"Results Obtained by Spreader

It's up to American Industry

From all over the world, frightened, helpless eyes peer through the mists of war toward American smokestacks. *Will children die of hunger? Will rifles in men's hands have bullets? Will the air above them swarm with friendly planes . . . or hostile?* It's up to American industry.

Because Koppers cuts across the whole American industrial scene like a common denominator, every new job for American industry puts fresh responsibilities on Koppers and some Koppers product.

Ships gliding down the ways with the hopes of civilization clinging about their bows, have been speeded into the service with bronze propellers from Koppers foundries. The plane soaring protectively above you probably has Koppers piston rings. The carriages of the anti-aircraft guns that rumble comfortingly past on their way to the coast were possibly built by Koppers.

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Koppers is mining vast quantities of coal for fuel. Koppers coke ovens are transforming much of that coal into coke, gas and the flood of other products which eventually mean munitions, drugs, plastics, synthetics, rubber and other indispensables.

With the lives of boys from your home and our homes at stake . . . and the hopes of engulfed nations in the balance . . . every word from an American factory becomes the world's greatest news story. It's up to American industry. Koppers Company, Pittsburgh, Pa.

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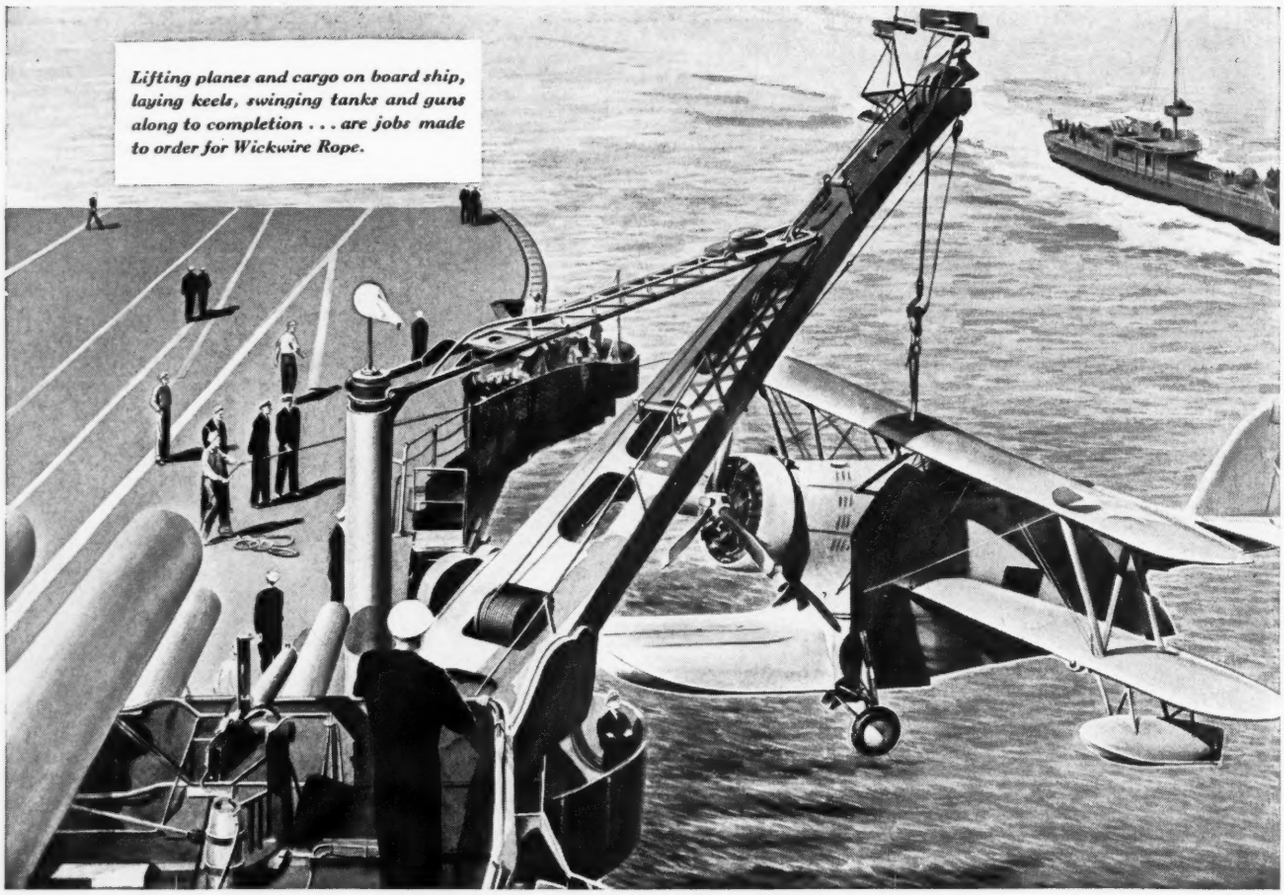
Lifting planes and cargo on board ship, laying keels, swinging tanks and guns along to completion . . . are jobs made to order for Wickwire Rope.

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Another Job for Wickwire Rope

It takes a lot of "heavy work" to win this war—and where the hoisting, hauling and pulling are toughest, there you'll find Wickwire Rope on the job.

The vital need for this vital steel tool of heavy industry points up a message to all users of Wire Rope.

Make your Wire Rope *last longer* . . . save steel too . . . by taking proper care of Wire Rope on the job.

And when you need Wire Rope, depend on Wickwire regular lay or pre-formed Wissco lay. Let our field men figure your exact needs, and show you how to get the most for the least. Then, after the Wickwire Rope is on the job, our field representative will also consult with you on ways to get most efficient performance.

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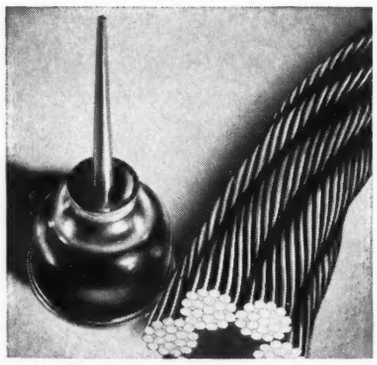
To make wire rope last longer, it's important to consult our authoritative manual "KNOW YOUR ROPES." More than 25,000 users all over the world consider it a bible on the selection, application and handling of wire rope. Write for free copy to: Wickwire Spencer Steel Company, 500 Fifth Ave., New York, N.Y.



THE LOWLY OIL CAN will pay dividends in making wire rope last longer. Internal wear can only be minimized by proper lubrication. Without it, there is excessive friction, binding and grooving which result in premature failure. This and forty more rope life-savers are fully described in our free booklet "Know Your Ropes."

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One hundred and twenty-two different standard types of *permanently insulated* wire have been developed by Rockbestos—all designed to give better and longer service *under severe operating conditions* in specific applications. They are built to *permanently resist* such wire-destroying hazards as heat and moisture, oil, grease, corrosive fumes and fire. This page shows a few that are widely used in industry. For further information send for our catalog.

RESISTS
Heat—Fire
Corrosive Fumes
Oil—Grease
Moisture

600 VOLT A.V.C. SWITCHBOARD WIRE—TABLE B

(Underwriters' Type AVB)

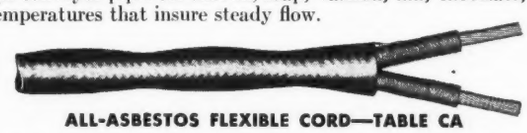
Sizes No. 18 to 4/0 A. W. G. with varnished cambric and felted asbestos insulation and gray, black, white or colored flameproof cotton braid.

Combine fire insurance and fine appearance in your switchboards with Rockbestos Switchboard Wire. It is absolutely fireproof and will not dry out under heat. Sharp, clean bends can be made without cracking as the asbestos wall acts as a cushion under the braid. Rockbestos A. V. C. Hinge Cable and Switchboard Bus Cable have the same fireproof and heatproof characteristics.

INDUSTRIAL HEATING CABLE—TABLE LH

No. 19 A. W. G. nickel-chromium wire insulated with .040" of felted asbestos and covered with 1/64" waterproof lead sheath.

This pliable cable distributes a mild heat evenly over a large area. Prevents freezing of water pipes, wet pipe sprinkler systems, etc. Keeps conveyor pipes for fuel oil, soap, varnish, ink, chocolate, etc., at temperatures that insure steady flow.



ALL-ASBESTOS FLEXIBLE CORD—TABLE CA

Sizes No. 10 to 18 A.W.G. with two or three conductors insulated with felted asbestos, covered with asbestos braid. Also in A.V.C. (asbestos and varnished cambric) constructions.

This heat-resisting flexible cord is ideal for high-wattage lighting units, floodlights, blueprint machines, apparatus, etc., which require a heavy duty, enduring cord. For moisture-resistant construction specify the A. V. C. type. Labeled cord with polarized conductors if desired.

600 VOLT A.V.C. BOILER ROOM WIRE—TABLE C

(Underwriters' Type AVA)

Sizes No. 18 to 4/0 A. W. G. This construction for sizes 18 to 8, sizes 6 to 4/0 have another wall of felted asbestos next to the conductor.

For lighting and control circuits exposed to heat and moisture, oil, grease, corrosive fumes or fire hazard, such as exist around furnaces, ovens, lehrs, soaking pits, boilers, etc., this widely used A. V. C. construction is ideal. Also for locomotive panel wiring and for switchboards requiring an asbestos braided wire.

ASBESTOS INSULATED MAGNET WIRE

Round, square and rectangular asbestos insulated conductors finished to meet varying winding conditions and coil treatment requirements.

Protect your motors against heat-induced breakdowns with class B windings of Rockbestos Heat-Resisting Magnet Wire. Leads of A. V. C. Motor Lead Cable will complete the failure-proofing.

THERMOSTAT CONTROL WIRE—TABLE TC

Sizes No. 14, 16 and 18 A. W. G. in two to six conductors with 12½, 25 or 31 mil wall of felted asbestos insulation and cadmium plated steel armor.

A multi-conductor control wire for low voltage intercommunicating, signal and temperature control systems. Its lifetime insulation and rugged steel armor will give you troubleproof circuits.

600 VOLT ALL-ASBESTOS RHEOSTAT CABLE—TABLE R

(Underwriters' Type AI)

Sizes No. 18 A. W. G. to 1,000,000 CM insulated with a heavy wall of felted asbestos, covered with a rugged asbestos braid finished in black, white or colors.

Use this power and rheostat cable for wiring rheostats, switchboards, elevator and locomotive control panels and electrical equipment exposed to heat, fumes and fire hazard. Also for general open wiring in dry, high temperature locations. For solid conductor specify Rockbestos Rheostat Wire, Table A.

600 VOLT A.V.C. MOTOR LEAD CABLE—TABLE L

(Underwriters' Type AVA)

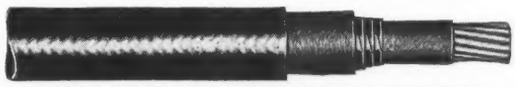
Sizes No. 18 A. W. G. to 1,000,000 CM insulated with two walls of felted asbestos and a high-dielectric, heat-sealed varnished cambric insert, covered with heavy asbestos braid.

Heatproof, fireproof, greaseproof and oilproof, this cable will not dry out and crack, won't burn or carry flame, and will remain permanently flexible. For coil connections, motor and transformer leads where extreme heat and fire hazards are encountered as in steel mills, boiler rooms, etc.

600 VOLT A.V.C. CONTROL CABLE

In one to 19 conductors. Standard stranding A. W. G. No. 12—19/No. 25 and No. 9—19/No. 22. Other strandings furnished.

Designed for use under conditions too severe for control cables with other types of insulation which deteriorate rapidly when exposed to high temperatures. Operates without failure under the attack of heat, oil, grease or corrosive fumes and may be installed in conduit as it has ample moisture resistance.



600 VOLT A.V.C. POWER CABLE—TABLE E

(Underwriters' Type AVA)

Sizes No. 18 A. W. G. to 1,000,000 CM insulated with laminated felted asbestos and varnished cambric, and asbestos braid. Other constructions for service voltages up to 8000.

This cable is recommended for power circuits and hot spot wiring in or around boiler rooms, ash pits, steam tunnels, soaking pits, tenter frames, glass plants, steel mills, etc. The asbestos and heat-sealed varnished cambric construction has ample moisture resistance and withstands high temperatures indefinitely.

ROCKBESTOS PRODUCTS CORP.
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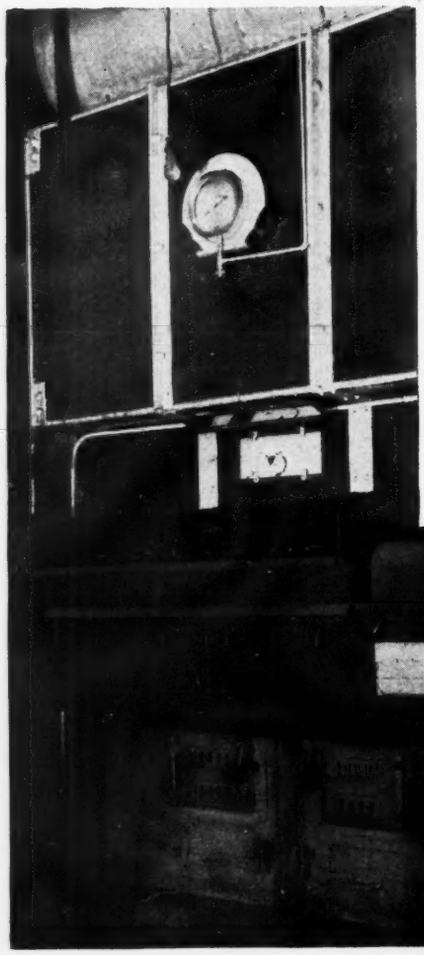
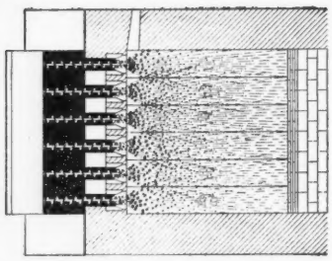
122 STANDARD TYPES

ROCKBESTOS

The Wire with Permanent Insulation





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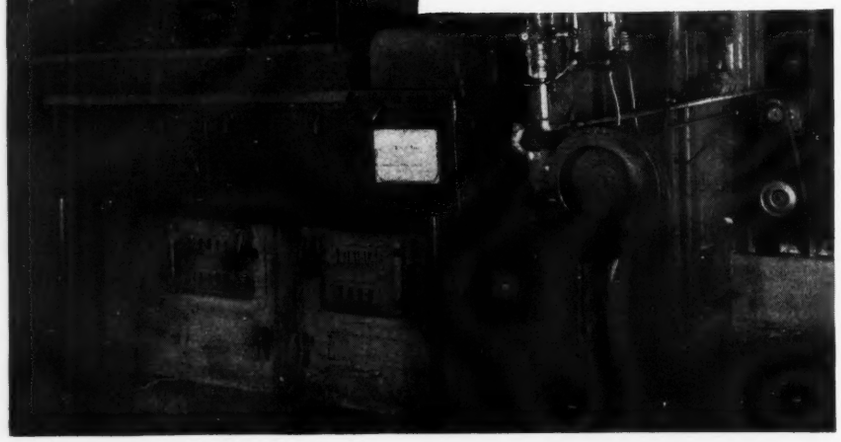
THE above plan view of a 6-burner FYR-FEEDER shows the uniformity of the coal distribution pattern.



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HERE is timely help for American industrial plants now worried about growing steam demands . . . fuel shortages . . . insufficient firing capacity . . . and dangerously overloaded equipment.

FYR-FEEDER Industrial Spreader Stokers can match or exceed the high heat release rates of any present method of firing and they can do it with practically any type of bituminous coal or lignite.

If you are now engaged in work vital to defense and civilian needs, don't overlook the fact that FYR-FEEDER Industrial Stokers are helping many organizations meet every need for higher capacity . . . simple, automatic operation . . . low investment, low fuel cost. *Ask for FYR-FEEDER facts.*

DELIVERY. Quick delivery of FYR-FEEDER Spreader Stokers is assured for industrial plants working on Defense contracts . . . plants producing essential civilian goods . . . food processing plants . . . institutions and schools . . . mines . . . utility plants . . . railroad steam plants . . . or plants otherwise qualified to obtain priority ratings. For complete details, use the coupon below.

TERRITORIES FOR SALES ENGINEERS

Some territories are open for experienced sales engineers familiar with steam plant boilers and furnaces. Information on request. Please furnish record of your experience and references.

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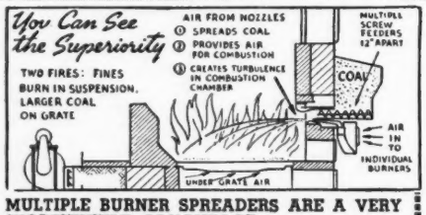
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AIR FROM NOZZLES
① SPREADS COAL
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TWO FIRES: FINES BURN IN SUSPENSION, LARGER COAL ON GRATE
COAL
AIR IN TO INDIVIDUAL BURNERS
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MULTIPLE BURNER SPREADERS ARE A VERY WORTHWHILE ADVANTAGE.
Each FYR-FEEDER has 2, or 4, or more burner spreaders giving dependability and convenience in cleaning grates, impossible to secure with a single spreader.

Stokers with Continuous Ash Discharge" by R N Bucks of Studebaker Corp; "Steam Boiler Circulation" by A A Markson; "Coal Research and the War Effort" by A W Thorson, Carnegie Institute of Technology; "Radial Diesels" by Prof E T Vincent, University of Michigan; "Diesel Vs Steam Locomotives" by Robert Aldag, Jr, C B Q Railroad Co.

Advance dinner and luncheon reservations may be made with C A Nash, Conference Secretary, Illinois Institute of Technology, 3300 Federal St, Chicago.

Technicolor Film Available

The Aluminum Company of America has prepared a technicolor sound film—"Unfinished Rainbows," made in Hollywood with Hollywood character actors, to portray the history of the aluminum industry. Prints have been prepared in both 16- and 35-mm. size, and are available, without cost, except transportation, for showings before organizations of standing, including schools, lodges, engineering societies, etc. Address inquiries to Wilding Picture Productions, 1345 Argyle St, Chicago, Ill.

WPB Eliminates Metal Jackets

Elimination of metal jackets, fusible plugs and tri-cocks from low-pressure heating boilers after June 1 was ordered recently by the War Production Board. The order, however, grants permission to producers to deliver any boilers in stock June 1, even if equipped with the jackets plugs and cocks, provided they are completely finished by that date. In addition, the regulations require that production of the metal jackets be ended on March 16. No limitation is placed on the manufacture of the plugs and tri-cocks, because they are used for other purposes than low-pressure boilers.

Approximately 18,000 tons of steel are expected to be saved by the elimination of the jackets, and 180,000 lb of brass by the elimination of the cocks and plugs.

Utility Repair Priority Order Being Rewritten

The utility repair and maintenance priority order is being rewritten by the War Production Board's Power Branch. The revised order will provide higher

MONEL tubing proves O.K. in SUPER-PRESSURE PRE-HEATER...

Now in use for nearly a year, this strong, corrosion-resistant metal fulfills expectations at Twin Branch

Designing a unit to generate steam at the record-breaking pressure of 2,500 lbs. called for something unusual in feed water pre-heaters. What *tubing* to use in the latter posed a problem for Indiana & Michigan Electric Co. and Foster Wheeler Corp.

The feed water heater at their Twin Branch plant handles 550,000 pounds of water per hour, at temperatures ranging from 353 to 490° F., under a pressure of 3,200 p.s.i. Maximum steam pressure and temperature *outside* the tubes are 700 p.s.i., 650° F.

Possessing a high rate of heat transfer and the corrosion-resistance and strength necessary to secure a tube of moderate thickness, Monel has proved entirely satisfactory. In this and numerous other ways INCO Nickel Alloys are helping meet demands for increased production of Power.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street **New York, N. Y.**

★

FIRST THINGS FIRST . . . With the Nation at war, supplies of Monel, Nickel and Nickel Alloys are needed for our armed forces. All efforts must now be aimed toward victory. In the meantime The International Nickel Company will continue to issue information which it is believed will be of interest to metal users who are concerned with the war needs of today and the peace-time progress of the future.

★ ★ ★ ★ ★ **INCO NICKEL ALLOYS** ★ ★ ★ ★ ★

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • NICKEL • "Z" NICKEL

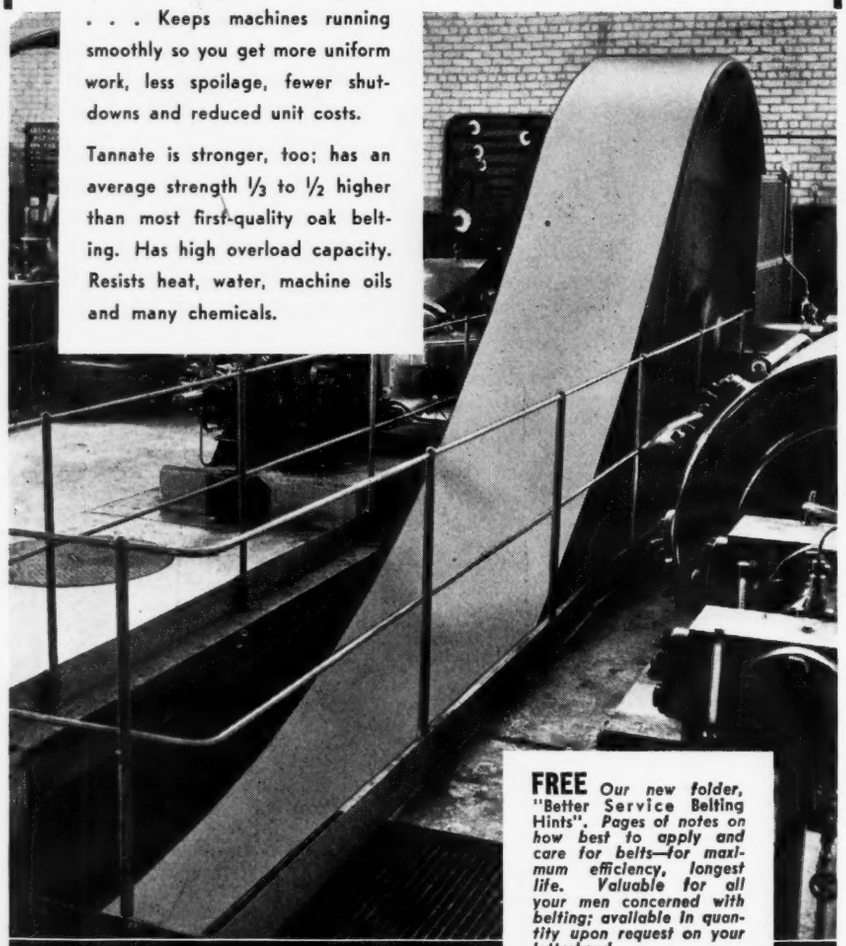
Sheet . . . Strip . . . Rod . . . Tubing . . . Wire . . . Castings

Don't wait for new machines . . . INCREASE OUTPUT OF PRESENT EQUIPMENT with TANNATE LEATHER BELTING

• *Survey your drives . . . Make sure your production schedules are not being slowed by slipping belts. Where that condition exists, remedy it at once; install Rhoads Tannate Watershed Leather Belts.*

Tannate grips tightly, pulls steadily, resists stretch and slippage . . . Keeps machines running smoothly so you get more uniform work, less spoilage, fewer shutdowns and reduced unit costs.

Tannate is stronger, too; has an average strength 1/3 to 1/2 higher than most first-quality oak belting. Has high overload capacity. Resists heat, water, machine oils and many chemicals.



FREE *Our new folder, "Better Service Belting Hints". Pages of notes on how best to apply and care for belts—for maximum efficiency, longest life. Valuable for all your men concerned with belting; available in quantity upon request on your letterhead.*

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STEP UP PRODUCTION with

RHOADS

Established 1702

Tannate **WATERSHED LEATHER BELTING**

ratings than the A-10 now permitted, at least for such commodities as copper, for which an A-10 is now virtually worthless.

Power Branch priorities staff members have drawn up a tentative revision which has been submitted to J A Krug, chief of the branch, for study.

In addition to the stepped-up priority rating the new order is to contain administrative and procedural changes which have proved advisable from the experience gained in the months since the original order was issued.

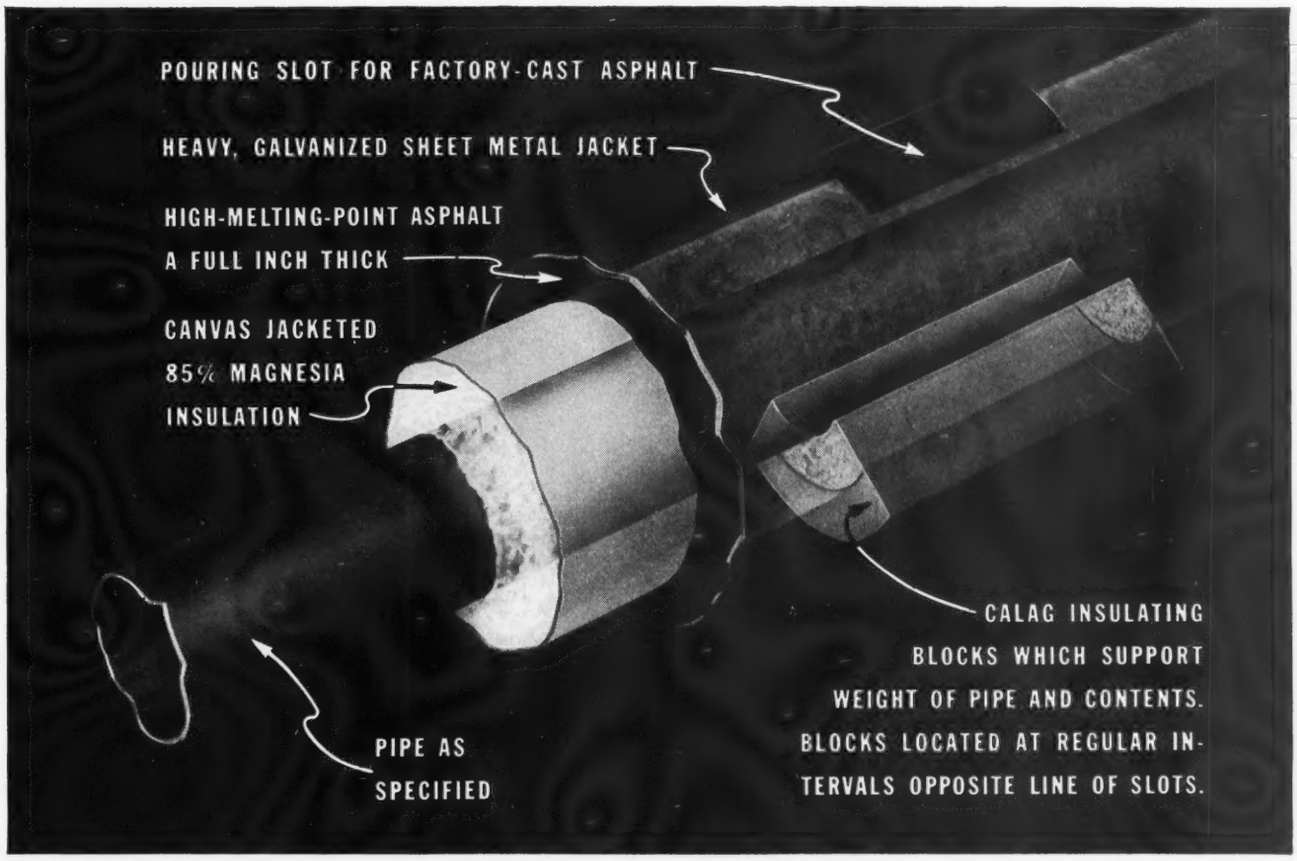
F E Ricketts Gets Lamme Medal

The 1941 Lamme Medal of the American Institute of Electrical Engineers has been awarded to Forrest E Ricketts, vice president, Consolidated Gas Electric Light & Power Co, Baltimore, Md., "for his contribution to the high reliability of power-supply systems, especially in the design of apparatus for selective relaying and circuit reclosure." The medal and certificate will be presented to him at the annual Summer Convention of the Institute, which is to be held in Chicago, June 22-26, 1942.

Mr. Ricketts was employed by the Consolidated Gas Electric Light & Power Co in 1905 as an electrician and has been with the company since then, serving successively as chief operator, superintendent of electric stations, and director of intersystem power utilization bureau, becoming vice president in 1938. He worked on the development of electrical testing methods, and safety and control equipment, and has invented devices relating to electric arc extinguishers, automatic electric regulators and relay systems. He joined the Institute in 1916 and has served on the AIEE Committee on Protective Devices and Transmission and Distribution.

Mr Ricketts was presented a Modern Pioneer award in 1940 by the National Association of Manufacturers.

FOR UNDERGROUND PIPE LINES



10 points of Advantage... ..for Ehret's D.I.P.

Steam supply and return lines of Durant Insulated Pipe, completely installed and ready for backfill

The high insulating efficiency of 85% Magnesia with the inch-thick protecting layer of Asphalt ensures for Ehret's Durant Insulated Pipe a long and trouble-free life of service. Added to this inherent value are 10 points of advantage that make Ehret's D.I.P. outstanding for underground service.

1. Insulation protection is absolutely dependable.
2. Permanently waterproof.
3. No sub-drains required. Complete water submersion does no harm.
4. Corrosion and electrolysis eliminated.
5. In multiple lines, individual Durant pipes can be added, removed or replaced without disturbing others.
6. No rollers or pipe supports required.
7. Tile or masonry protection not required.
8. Minimum trenching and field work.
9. No breakage or waste of material during installation.
10. Field costs are much lower than those of tile, tunnel and similar systems.

Send for the Ehret D.I.P. Booklet. It gives complete information on this modern system for underground insulated piping.

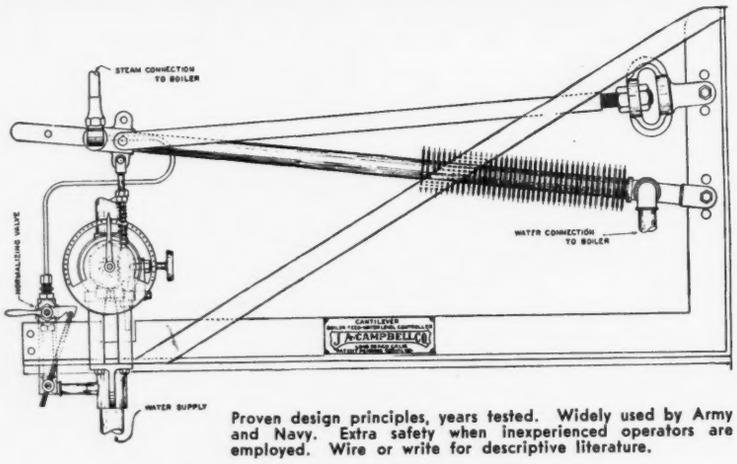
EHRET MAGNESIA MANUFACTURING COMPANY
VALLEY FORGE • PENNSYLVANIA

DISTRIBUTORS IN ALL PRINCIPAL CITIES

Don't impose extra NERVE STRAIN on your men

These are hectic, nervous days. You caution your men to be "on alert", but nerves do crack! Nerve strain of watching water levels in your boilers can be avoided. High tension of your boiler men and inadvertent oversight during these trying war days will not hazard your boilers when you install the Campbell Cantilever Boiler Water Level Controller. You get positive, precision control for the price of an ordinary Regulator—and more, too. You get safety far beyond any standard set up by Safety Boards.

CAMPBELL CANTILEVER BOILER WATER LEVEL CONTROLLER



Proven design principles, years tested. Widely used by Army and Navy. Extra safety when inexperienced operators are employed. Wire or write for descriptive literature.

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They WEAR themselves into perfect condition

Tests prove that Sea-Ro Graphitized Rings acquire a hard glass-like surface after long operation, and being of a floating type, reduce wear on cylinder liners.

Sea-Ro No. 528 Rings are recommended for plungers of pumps handling hot or cold water, oils, gasoline, solvents, ammonia, etc.

For large heavy-duty, use Sea-Ro No. 525 Rings, with patented internal expansion spring.

SEA-RO GRAPHITIZED PUMP PLUNGER RINGS No. 528

Send for detailed information.

SEA-RO PACKING CO., INC., WOOD-RIDGE, N. J.

THIS NEW BOILER OPERATOR'S GUIDE ... can mean money to you!

JUST OUT! Here's information of the most priceless sort for you — whether you want to improve your ability as an inspector or to utilize effective inspection methods in the more efficient, safer operation and upkeep of your own boilers.

Helps you meet everyday problems; Prepares you for license exams

With hundreds of typical examination questions and answers as well as complete instructions, this book presents fully and plainly the things you want to know about proper installation, operation, and care of boilers—the things that prevent dollars of loss in reduced efficiency, breakdown, or even accident.

By H. M. Spring, Jr.
353 pages, 6 x 9
241 illustrations
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Send me Spring's Boiler Operator's Guide for 10 days' examination. In 10 days I will send you $3.00, plus few cents postage or return book postpaid. (We pay postage on orders accompanied by remittance.)

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Priority Classification

Federal power generation operating agencies are all classified just below the military departments and the War Production Board in a formal "priority system" established recently for Government employees. The classification was established under an executive order of the President to facilitate transfer of Government workers to essential war jobs.

Under the regulations any employee may be transferred to any agency cataloged with a higher rating than the one for which he works. It is estimated that thousands of employees in regular agencies will be shifted to direct wartime duties.

Bonneville Power Administration, Bureau of Reclamation (power staff), Army Engineers power projects staff) and Tennessee Valley Authority are all listed in Class 2. Rural Electrification Administration is cataloged in Class 4. Class 3 agencies include the Federal Power Commission, Department of Interior Power Division and National Power Policy Committee.

Aluminum Expansion

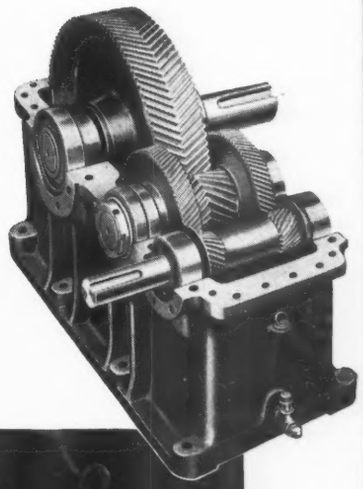
The War Production Board's formal announcement of huge additional expansion of aluminum and magnesium production discloses the WPB Power Branch policy of loading up utilities with firm demands upon generating facilities practically up to the total nameplate capacity of their stations, including units normally classed as reserves.

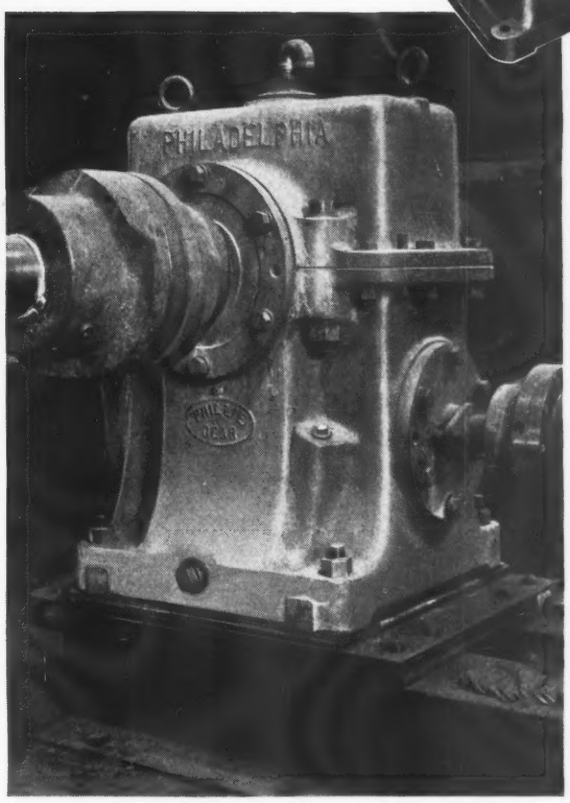
Three of the large new aluminum plants of perhaps 15,000,000 lb capacity each are virtually certain to be located in New York, Philadelphia and Boston or Hartford. In each instance, it is estimated that at least in peak load periods the aluminum load will be served in part with reserve generators. Chicago originally was considered for the fourth projected plant but more recently it has been decided that power reserves there are inadequate and this capacity probably will be crammed into existing plants in the Northwest and California.

Bulk of the magnesium expansion will utilize new ferro-silicon processes using natural gas rather than electric power for fuel, both because such plants can be built more quickly and because of the increasing difficulty in locating large blocks of kilowatts for a single operation.

Aluminum, however, is not the only war production expansion which is being assigned to utilities on the Power

We build our Speed Reducers to Stand... 21 days a week service





A horizontal type Philadelphia Worm Gear Speed Reducer installed at an Arizona Copper Mine.

The three-shifts-a-day working schedules of industry today place heavy demands on drive equipment. Speed reducing units, many of which were installed to operate a normal 8 to 10 hour day, are now in service continuously. Because of this, premature breakdowns may follow with replacements necessary.

For either replacing worn drives or for new installations, investigate Philadelphia Speed Reducing Units. They are built in all types with every unit having custom built qualities and individual service characteristics that assure their performing with maximum economy and efficiency. Our engineers can recommend units for practically any drive condition with proper ratings, both thermal and horsepower, to assure long, trouble-free operation. Philadelphia Units are ruggedly constructed and amply housed with adequate heat dispersion areas. Tell us your needs.

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INDUSTRIAL GEARS AND SPEED REDUCERS LIMITORQUE VALVE CONTROLS

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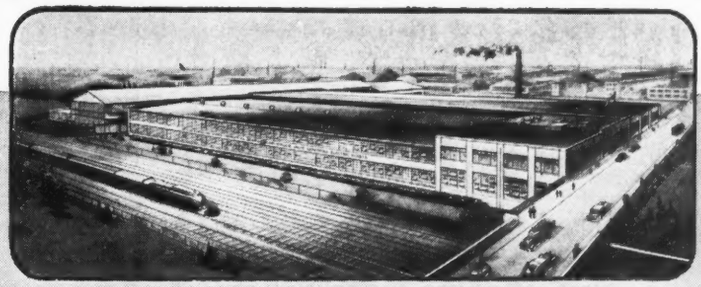
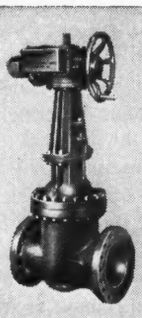
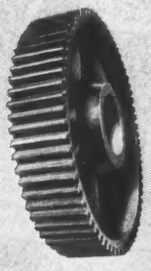
PHILADELPHIA, PA.
New York, Pittsburgh, Chicago

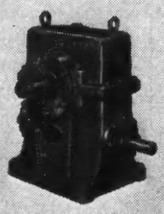




***Philadelphia* LIMITORQUE CONTROL**
operates all types of valves, etc., safely, economically, from convenient stations.

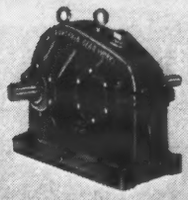


***Philadelphia* GEARS**
All types and sizes of industrial gears. Can be supplied in all materials.



***Philadelphia* WORM GEAR SPEED REDUCER**
right angle drives — vertical or horizontal. Wide range of ratios and horsepowers.

***Philadelphia* MOTOREDUCER**
The economical self-contained drive, Horizontal or Vertical types — various ratios and horsepowers.



***Philadelphia* HERRINGBONE SPEED REDUCER**
for heavy loads at high speed. Single, Double, Triple Reductions, various ratios and horsepowers.

FIND OUT HOW LITTLE PERMANENT CONDUIT COSTS

ADSCO BANNON TILE IS THE MOST ECONOMICAL *Permanent* FORM OF CONDUIT

Engineers realize that the heat loss from makeshift steam lines can be very costly for the duration.

This is why more and more ADSCO-Bannon Tile Conduit is being ordered for the steam and hot water lines at army camps—naval and air bases, defense plants and housing projects.

Available with base drain, in sizes from 4″-24″ inclusive, with ADSCO Filler Insulation — a "Fiberglas" product, it makes a PERMANENT installation of high thermal efficiency.

Find out how little it costs to have PERMANENT steam lines. With the facilities of our big tile plant, chances are we can save you valuable time. Write for quotations or Bulletin No. 35-67PR.

ADSCO MAKES COMPLETE STEAM LINE EQUIPMENT

ADSCO Internally-Externally Guided Expansion Joint

Save yourself unnecessary correspondence and phone calls — avoid the hazards of divided responsibility — maintain a better working schedule by ordering all your steam line equipment from ADSCO — Conduit — Insulation — Expansion Joints — Pipe Line Accessories, etc. — everything you need for efficient and economical steam line installations.

Write for complete Catalog No. 35PR which describes and illustrates the complete line of ADSCO Products.

AMERICAN DISTRICT STEAM COMPANY NORTH TONAWANDA, N. Y.

Makers of "UP-TO-DATE" Steam Line Equipment For Over 60 Years

Branch policy of loading up power systems to rated capacities. This is now the prevailing policy in planning sites for new plants and expanding operations in existing ones.

The Power Branch takes the position that the standard practice of having extra capacity equal to the largest unit in operation spinning at all times is too great a luxury for the nation to afford in this period. Instead, J A Krug and his staff are working with utilities to find substitute methods for meeting emergency outages which may occur during periods when all equipment is carrying load.

Federal Power Commission, through its regional offices, recently has been urging utilities to adopt plans for meeting emergency outages by identifying blocks of load which could be cut immediately, but for brief periods, and for a protracted period, after advance notice. The FPC and WPB programs are being carried on independently of each other.

Utility Council Formed

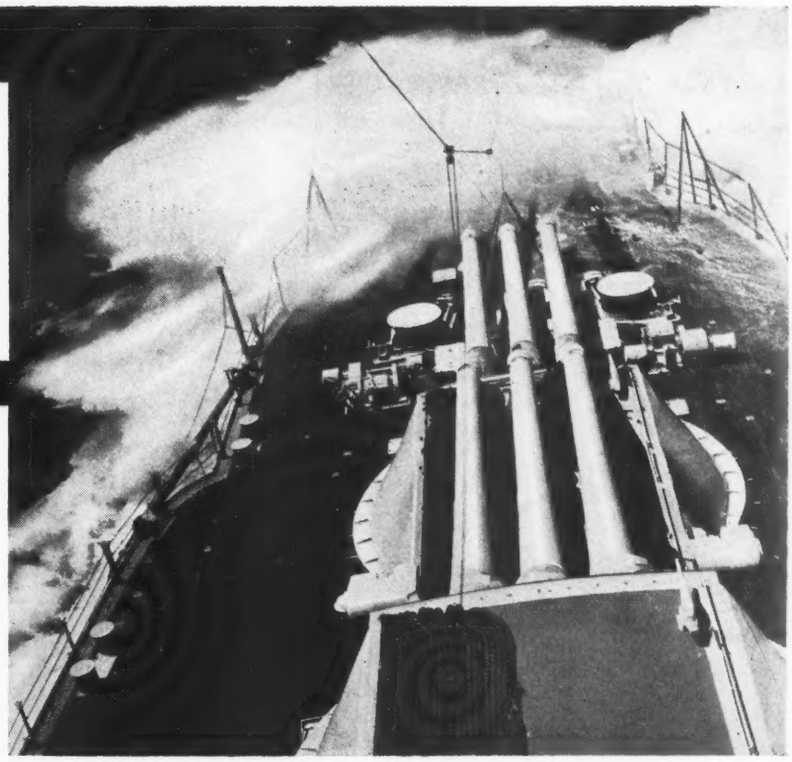
Formation of a national Council of Electric Operating Companies was announced formally in Washington on March 6 for the purpose of extending the fullest cooperation of participating utilities to the Federal government in the war emergency. The new group is composed of operating electric utilities throughout the United States.

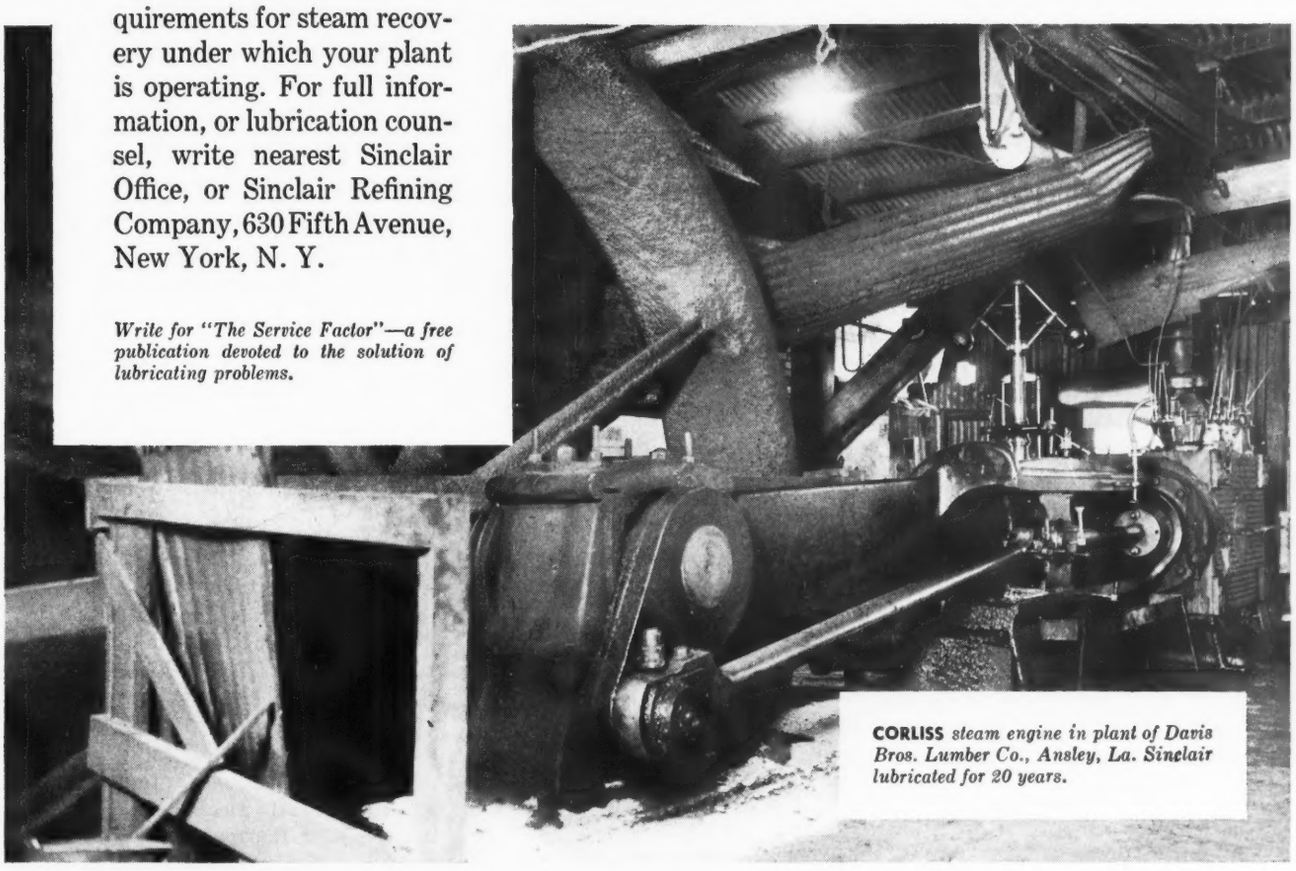
Tom P Walker, president of the Gulf States Utilities Co, Beaumont, Tex., made the announcement as president of the new organization and chairman of the initial committee of the Council.

WAR SCHEDULES suffer if power house lubrication is inadequate. For *STEAM ENGINES* there are . . .

. . . SINCLAIR STEAM CYLINDER and VALVE OILS giving efficient lubrication under normal top loads and today's emergency overloads. These lubricants meet any combination of pressures, temperatures, moisture conditions and requirements for steam recovery under which your plant is operating. For full information, or lubrication counsel, write nearest Sinclair Office, or Sinclair Refining Company, 630 Fifth Avenue, New York, N. Y.

Write for "The Service Factor"—a free publication devoted to the solution of lubricating problems.





CORLISS *steam engine in plant of Davis Bros. Lumber Co., Ansley, La. Sinclair lubricated for 20 years.*

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War Orders Call for Higher Pressures AND R/M PACKINGS

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R/M packings are solving these problems in many different industries. R/M research laboratories are steadily invading and conquering unexplored fields. R/M production is regularly setting new records in an effort to meet the unprecedented demand.

The keyed, illustrated and indexed R/M catalog, which specifies for all ordinary applications, is yours for the asking. In it you will find the answers to most of today's industrial packing problems. See your R/M distributor or write for your free copy.

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Makers of Packings for Every Industrial Use

Mr Walker plans to resign his utility post in order to devote full time to directing the Council's activities from Washington headquarters to be opened about April 1.

"The purpose of the Council is to assist various governmental agencies responsible for the war effort by coordinating the experience, manpower and equipment of the electric operating companies," Mr Walker stated in his announcement.

Power Supply Vital

"Power supply is a vital factor in war time. This problem alone offers immediate and important opportunities for constructive cooperation between the industry and the government."

Mr Walker spent several days in Washington prior to the formal announcement, apprising various government power officials of the formation of the new group and its program.

Other members with Mr Walker of the Council's initial committee are:

Ernest R Acker, president, Central Hudson Gas & Electric Corp, Poughkeepsie, N. Y.; H C Blackwell, president, Cincinnati Gas & Electric Co, Cincinnati; G B Buck, vice president, Public Service Co of Colorado, Denver; Price Campbell, president, West Texas Utility Co., Abilene, Tex.; John P Coghlan, vice president, Pacific Gas & Electric Co, San Francisco; Charles A Collier, vice president, Georgia Power Co, Atlanta.

Other Members

Sutherland Dows, president, Iowa Electric Light & Power Co., Cedar Rapids, Ia.; Samuel Ferguson, president, Hartford Electric Light Co, Hartford, Conn.; R A Gallagher, president, Public Service Co of Indiana, Indianapolis; H P Liversidge, president, Philadelphia Electric Co, Philadelphia; P H McCance, president, Duquesne Light Co, Pittsburgh; Donald C McClure, president, Central Illinois Electric & Gas Co, Rockford, Ill.; G C Neff, president, Wisconsin Power & Light Co, Madison, Wis.

James H Polhemus, president, Portland General Electric Co, Portland, Ore.; K M Robinson, president, Washington Water Power Co, Spokane, Wash; W H Sammis, vice president, Consumers Power Co, Jackson, Mich.; H M Sawyer, vice president, The Ohio Power Co, Newark; Chester C Smith, president, Kansas City Power and Light Co, Kansas City, Mo.; A C Spurr, president, Monongahela West Penn Public Service Co, Fairmont, W. Va.; L V Sutton, president, Carolina Power &

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PHOSCALOID

To the many hundreds of pre-war users of PHOSCALOID now is added a new army of users who cannot get (on account of Government restrictions) the phosphates they formerly used. They are also finding in PHOSCALOID what present users discovered long ago . . . . that it is definitely the least expensive source of phosphates for maintaining calcium-free boiler concentrates, which in turn becomes the least expensive method of maintaining scale free boilers . . . . that its use as an after treatment for Lime-Soda Softening Plants is not only more effective but at 50 to 60% lower cost . . . . that this organic compound of phosphate is also more effective than less modern methods in eliminating hard scale and sludge . . . . that it will not leave any feed line deposits—never has . . . . that in many instances, periods between boiler cleanings have been extended from 2 to 3 months to 2 years.

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WATER CHEMISTS AND ENGINEERS

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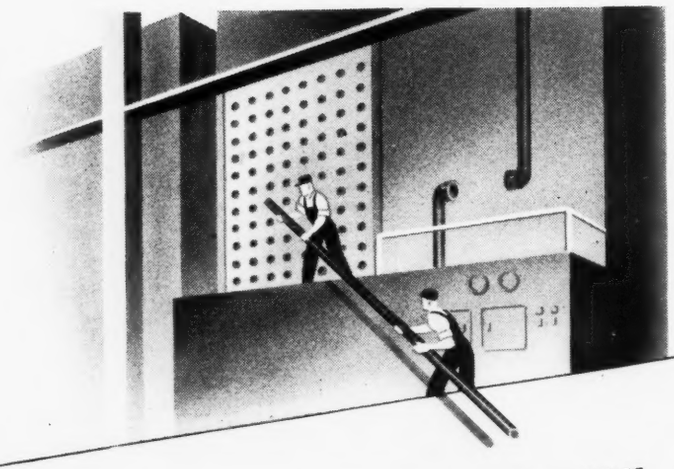

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GET MORE POWER AND LONGER LIFE
FROM YOUR PRESENT BOILERS

KEEP your boiler feed water free from scale-forming silica and organic substances with Ferrisul—and you'll add vital extra pounds to your steam output and equally vital hours to the life of your boiler tubes and turbine blades.

Ferrisul (anhydrous ferric sulfate) rids boiler feed waters of silica and other enemies of heat transfer efficiency *without* leaving equally dangerous, scale-forming or corrosive residuals. Because its floc is highly adsorptive, forms immediately and is stable over the entire pH range above 3.5, even small amounts will remove some silica and complete removal of both silica and organic substances is usually both practical and economical.

Dry and free-flowing, Ferrisul is easy to handle and requires no expensive storage tanks. It can be carried by any standard conveyor system and introduced into the treatment in standard dry feed machines or solution feeders. It is shipped in sturdy, moisture-proof containers which can be stored indefinitely without danger of deterioration or in Dry-Flo freight cars which can be automatically unloaded as easily as liquid from a tank car.

Monsanto's experienced technical staff will be glad to study your needs and recommend the most economical and effective treatment for your particular system. For full details, inquire: MONSANTO CHEMICAL COMPANY, Merrimac Division, Everett Station, Boston, Massachusetts.

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"E" for Excellence . . . the pennant denoting the highest service accomplishments in the United States Navy . . . flies with the Naval Ordnance flag over Monsanto. In the words of the Secretary of the Navy, this award has been made to Monsanto "in recognition of your outstanding efforts in the production of ordnance materiel vital to our national defense."

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Light Co, Raleigh, N. C.; G W Van-Derzee, vice president and general manager, Wisconsin Electric Power Co, Milwaukee, Wis.; Edmund W Wakelee, president, Public Service Electric & Gas Co, Newark, N J; T W Wilson, president, Delaware Power & Light Co, Wilmington; John S Wise, Jr, president, Pennsylvania Power & Light Co, Allentown; W E Wood, president, Virginia Public Service Co, Alexandria, Va.; and H E Young, vice president, Northern States Power Co, Minneapolis, Minn.

WPB Asks Return of Empty Freon Cylinders

The refrigeration and air-conditioning branch of the War Production Board March 3 asked all stores, restaurants, factories, theaters, studios, laboratories and film exchanges to ship back all empty freon cylinders to their manufacturers so that they may be refilled and used again for air-conditioning. Freon gas is used in commercial air-conditioning.

The cylinders are made out of pressed steel, a critical material, and unless empty cylinders now on hand are returned to the manufacturers by March 10, only two-thirds of the scheduled production of freon gas for March can be packaged. No new cylinders are obtainable and the manufacturers of freon must depend on cylinders already made to pack their entire supply.

War Boosts Industrial Lighting Levels

America's war effort has boosted lighting levels in modern defense plants four times their peacetime strength to speed production and protect the nation's industrial workers against eye strain caused by overtime hours. The subject of industrial lighting was discussed by S G Hibben, Westinghouse director of applied lighting, at a meeting of the American Optometric Association, in New York City.

Widespread vision defects during the first World War were caused by poor industrial lighting. During the present emergency, however, American industry is making every effort to save the worker.

Since the start of the defense program, modern plants have increased lighting levels from an average of 10 footcandles to 40 and 50 footcandles, the new standard for adequate installations. These levels are 13 or 14 times greater than the average of three

COOLER UNIT PREFABRICATED IN Shaw COMPANY PLANT and Shipped as a Complete Unit

CONVINCING Evidence of Why You Can Depend on Shaw Piping.

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Whether your piping problem is simple or intricate, high or low pressure, or a case of design, prefabrication and erection, Shaw is equipped to handle it. Forty-nine years of specialized experience has given the Shaw Company a wealth of practical knowledge that will save you time and money. For safe, dependable performance, specify SHAW PIPING.

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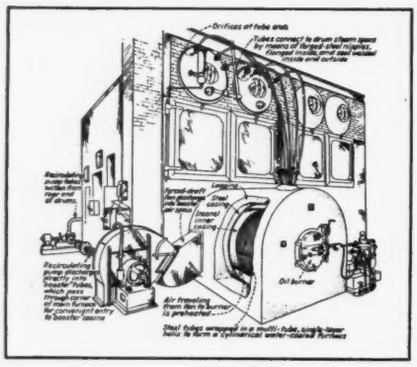
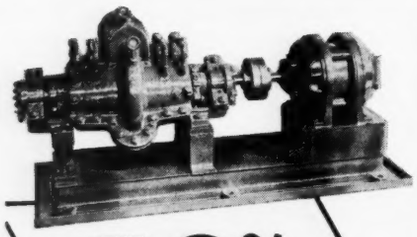
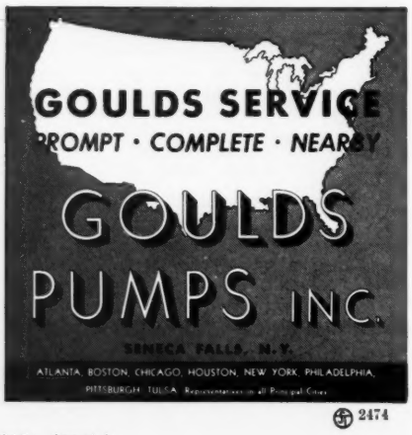




50% CAPACITY INCREASE

This "boiler booster" installation, engineered by the W. D. Lamont Steam Generator Co., gives B. Altman & Co. of New York a 50% increase in steaming capacity of a 35-year-old boiler—plus definitely increased efficiency. Two Goulds Fig. 3410 hot liquid centrifugal pumps like the one shown above contribute to this news-making installation—recirculating 300 GPM of water under 300 lbs. pressure at 412° F.!

Whatever your need, Goulds builds a pump to meet it. If it is large or small—for general or special application — Goulds can, other things being equal, give you better delivery because Goulds is exclusively a pump manufacturer—the nation's largest—with a production set-up that insures speed plus accuracy. And there usually is a Goulds branch office, agent or distributor nearby to give you quick, correct information and service on any pumping problems. Concise, complete, up-to-date catalog information is available instantly. We're ready to help you in any way we can. Why not let us?



2474

footcandles used by industry from 1914 to 1918.

Much of the present increase in industrial illumination comes from the development of the fluorescent lamp, a slender glass tube which emits cool, economical light through the action of ultraviolet on a coating of chemical phosphors. More than 20,000,000 fluorescent lamps were installed in factories and today industrial practice is leading the way toward better illumination for its employees both in the shop and in the office. When the war has ended, this pioneering is expected to result in setting the same high standards for homes, schools, and public buildings of all types.

WPB Pushes War Production Drive

In a nation-wide campaign to enlist the active cooperation of all American workers and managers to lick the Axis, the War Production Board has issued the Official Plan Book of its "Production Drive". Briefly and simply, this instructs every plant to organize immediately a joint committee of labor and management. The real job of this committee is to get everybody enthusiastically behind war production, and to speed the victory of the United Nations. Detailed suggestions are given for the use of shop production charts, bulletin boards, posters, slogan contests, etc.

The production drive committees will closely study such problems as taking care of tools, preventing breakdowns, reducing accidents, improving lighting, maintenance and repair, adapting old machines to new uses, cutting waste, breaking production bottlenecks, using every machine and other facilities to the fullest extent.

Distributing the official plan book, Donald Nelson, Head of WPB, again warned management, "There are two ways to get production. First is for government to provide blueprints of what is wanted; the schedule for when it is wanted; to see that adequate facilities are available for these machines, and then have management and labor bend every conceivable effort to achieve maximum production quickly. That is the American way . . . there is but one other way. That is the way of our enemies. That is the way of bondage and slavery. That is also the way to the destruction of everything we have fought for and worked to maintain and cultivate from the day this nation was formed".

PROTECTION FOR STEAM LINES—

On Guard for the duration

and a lifetime after!

"TOS" All Bronze Relief Valve. Use it where specifications require an exposed spring type valve impervious to corrosion in air, steam or liquid service. Has big relieving capacity; sturdily built for very long life.

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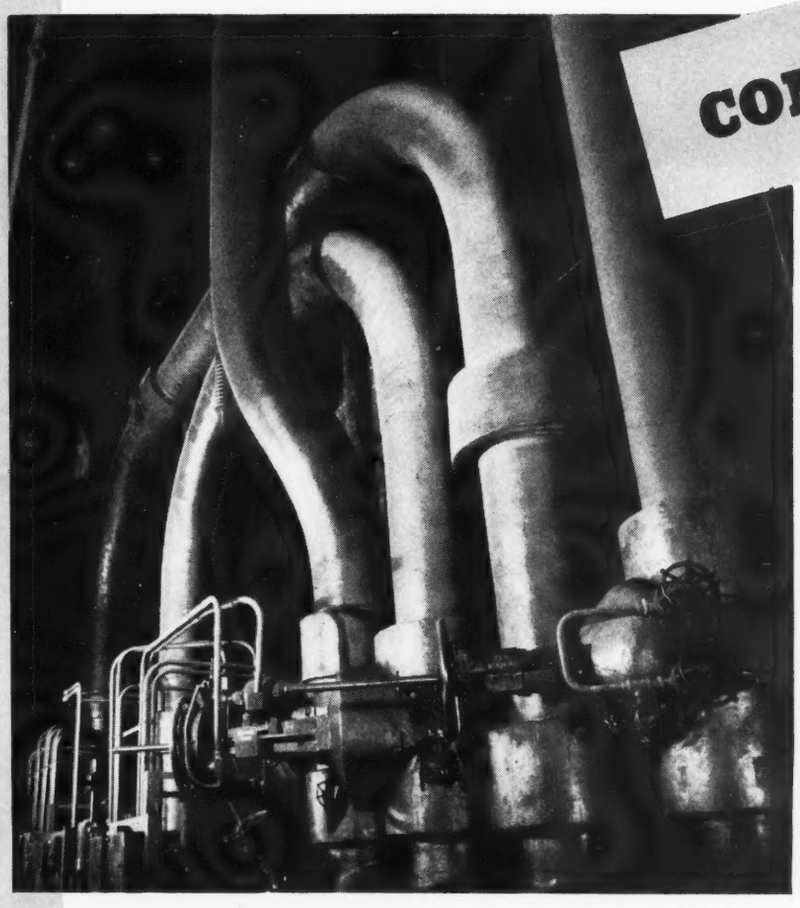

Accurate Time-Saving Piping Fabrication

MODERN piping systems require more and more emphasis on accurate fabrication within very close tolerances. At Pittsburgh Piping such accuracy begins in the engineering department where every installation, whether a single assembly or a complete system, is carefully planned and detailed for efficient shop fabrication. Assemblies are pre-fabricated as large as shipping facilities and installation space will permit, resulting in faster and simplified field erection.

Valuable construction time is further saved by scheduling all work through the shop in direct relation to the sequence of work in the field. Delays are eliminated and the work progresses according to a pre-arranged program.

WHEN contemplating your next piping installation, remember that Pittsburgh Piping has complete facilities for either fabricating, or fabricating and erecting your requirements. Get in touch with your nearest Pittsburgh Piping representative listed below.

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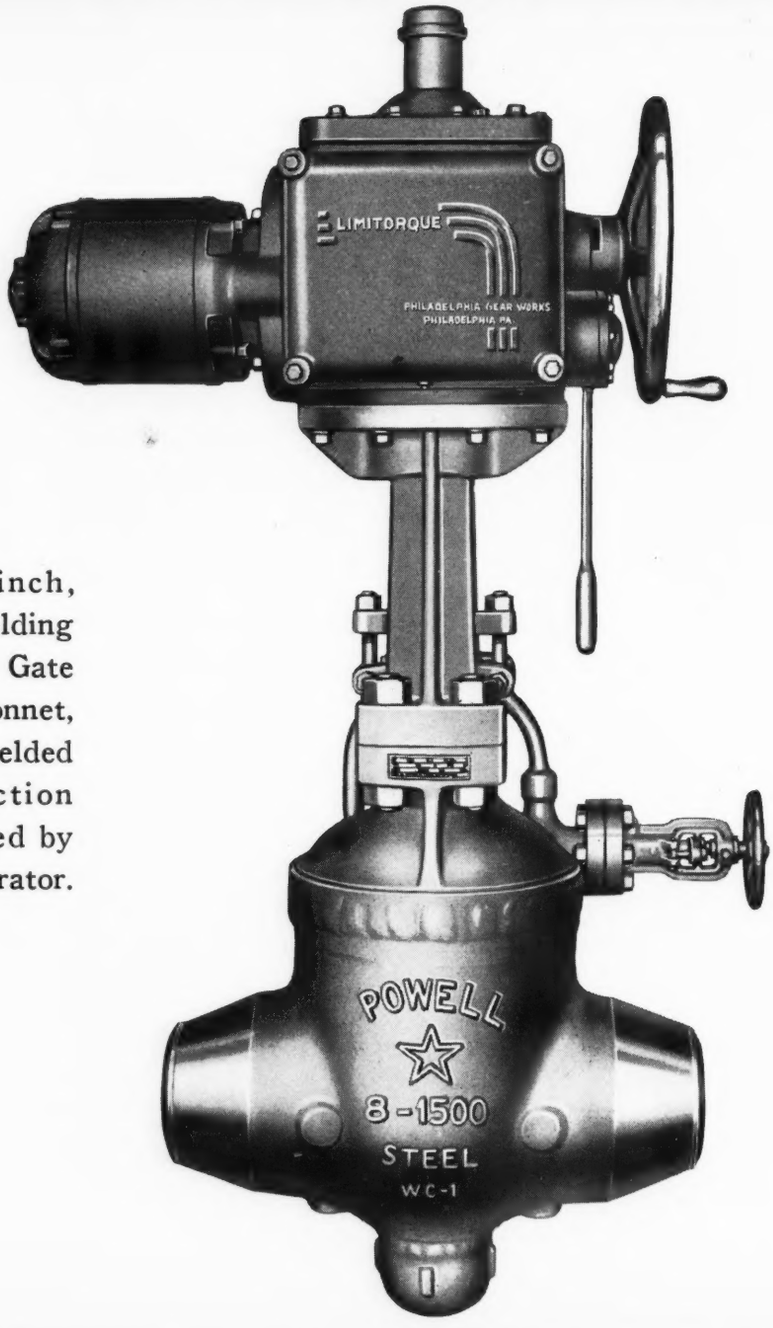


Shown here is an 8-inch, Class 1500 pound, welding end, cast alloy steel Gate Valve, with welded bonnet, special by-pass, and welded sediment and inspection cap. Valve is powered by Limitorque Motor Operator.

POWELL

NAME

You don't build a good name in a day or a year. It comes from doing a good job for a long time. After that, people begin to expect a good job from you and they bring their business to you for that reason.

We've been at our job a long time. Just four years short of a century. All these years we've been making valves. With each new industrial development in which valve design has played a part we've made new valves or adapted existing models to changing needs. In each instance our efforts have met with the approval of the Industry which was served.

This experience has taught us to expect changes and to be prepared for them. It has led us to build up a well trained engineering and research department fully equipped to handle new valve problems as they arise in the Progressive march of American Industry.

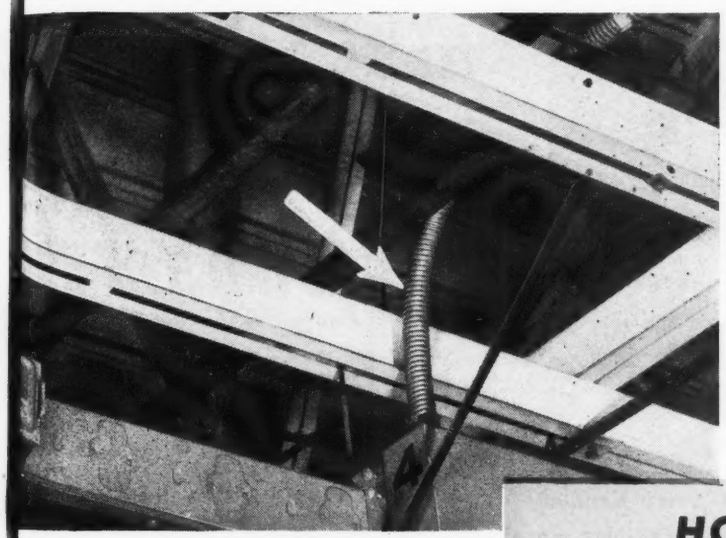
The Powell Line itself is evidence that we have not been idle. The ever-increasing demand for Powell stock valves and Powell engineering service is a constant reminder that the job we have been doing all this time has satisfied our clients, and has given them reason to expect that it will continue to be good. This is, in our conception, the meaning of a good name.

THE WM. POWELL CO., Cincinnati, Ohio

VALVES

This
G-E Cable
No. 1799 Varnished-cambric
Interlocked-armor Power Cable
FEEDER-RUNS IN A
SHELL-LOADING PLANT
Run of eight, 3-conductor, 600-volt, v-c interlocked-armor cables. See the simplicity of suspension and note that the cable can be trained easily. No. 1799 v-c has been submitted for National Electrical Code approval for voltages up to and including 5000—and is now listed by the Underwriters' Laboratories for 601 to 5000 volts.

Saves Vital Materials and Goes Up Fast



FOR REDISTRIBUTION. Here v-c interlocked-armor (600-volt) cable feeds into Trumbull Flex-A-Power bus for redistribution to the machines. This is a 500,000-cir mil cable.

General Electric and its employees are proud of the Navy award of Excellence made to its Erie Works for the manufacture of naval ordnance.

IF ever there was a cable of the hour this is it! You can install it in less time than previous combinations. It saves tons of vital materials; and electrically it's as good as, or better than, the combinations previously used for power runs up to 15,000 volts.

Are you planning new or additional construction for war production? If so, we'd like to help you make advantageous use of v-c interlocked-armor cable in your plant layout, and figure what the estimated savings will be. Consult our office in your locality, or write to General Electric, Schenectady, N. Y.

HOW MUCH DOES IT SAVE?

Calculations based upon requirements for a 3000-kva load—floor space, 450 by 700 ft

DISTRIBUTION METHOD	POUNDS OF MATERIALS			
	COPPER	STEEL	OTHER	TOTALS
Conventional Radial—with Rubber Cable and Conduit	18,500	43,500	4600 (mostly rubber insulation)	66,600
Conventional Radial—with V-C INTERLOCKED-ARMOR CABLE	13,600	5,070	4420 (rubber negligible)	23,090
SAVINGS	4,900	38,430	180	43,510
Load Center—with Rubber Cable and Conduit	4,560	16,150	4190 (947 lb rubber)	24,900
Load Center—with V-C INTERLOCKED-ARMOR CABLE	3,420	2,015	4140 (rubber negligible)	9,575
SAVINGS	1,140	14,135	50	15,325

SPEAKING OF SAVINGS!

This cable is ideal for use with G-E unit substations for load-center distribution—a practical means of bringing the economies of high-voltage power indoors, close to the point of use, where it is redistributed at lower voltage. Ask for publication GEA-3758.

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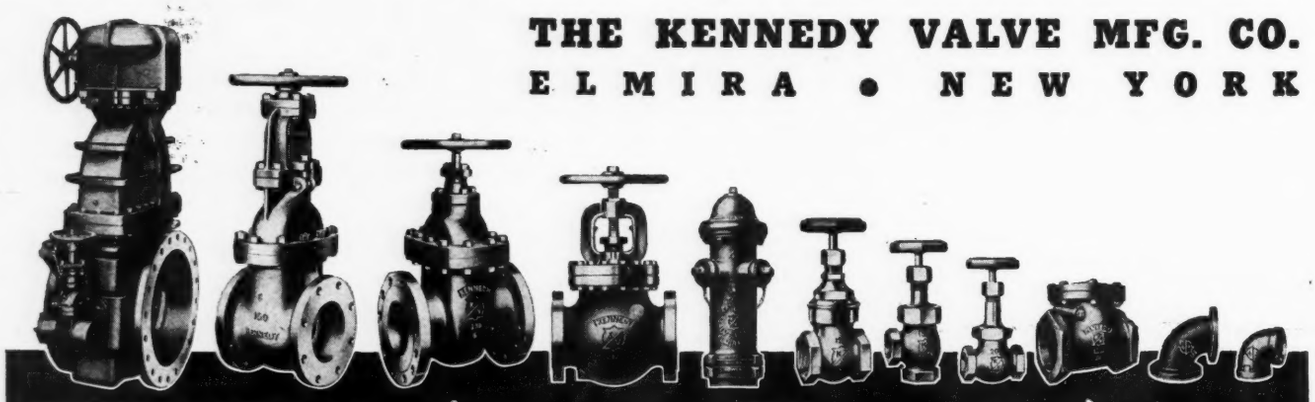
501-12-1200

"HERE'S WHY WE PREFER KENNEDYS CHIEF"

"Look at those wide passageways and that clean machine work, Chief. Take that one little detail of the milled stem-head recess in the disc holder and the rounded bottom surface of the stem head in this bronze globe valve. It helps me start the valve open and close it tight. And notice that fine-grained metal. I'll bet this valve will never leak."

"Every Kennedy Valve has good points like these. That's why we should use nothing but Kennedys for that new war plant."

Because of the uniformly good design, and excellence of workmanship and materials in Kennedy Valves, they are being installed in many plants, ships, housing projects and other war efforts.

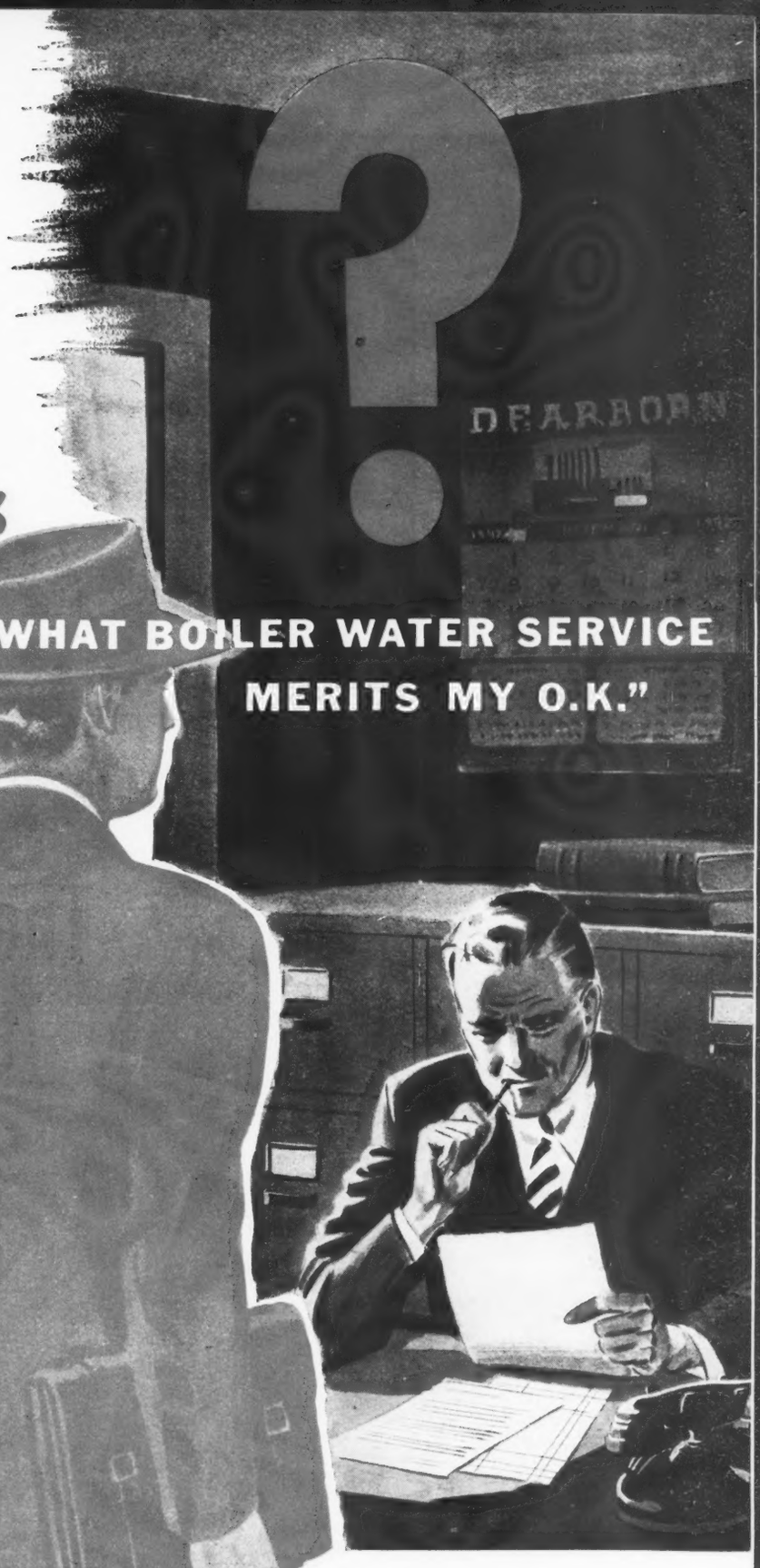


THE KENNEDY VALVE MFG. CO.
ELMIRA • NEW YORK

KENNEDY *valves... pipe fittings... fire hydrants*

DEARBORN ENGINEER HAS

the answer to the Chief's Question..



"WHAT BOILER WATER SERVICE MERITS MY O.K."

Doping the water is not the answer. Installing equipment for feeding chemical treatment, while important, is not the answer either. Boiler water treatment service has to be much more individual and scientific than that.

Dearborn Engineer recognizes that from the very start. But his accumulated experience enables him to come up quickly with the correct answer to your problem. He knows local water characteristics, too, because he has worked and lived in his district a long time. He studies the operating conditions of your plant, recommends correct treatment, and then keeps in contact with you periodically to see that full efficiency is maintained.

Power plant engineers lean heavily on that kind of scientific service . . . a thoroughly rounded 6-point service. Over 8000 power plants use it. Acquaintance with the Dearborn Engineer will reveal a service which fully merits *your* O.K. Drop us a line . . . we'll arrange for him to see you.

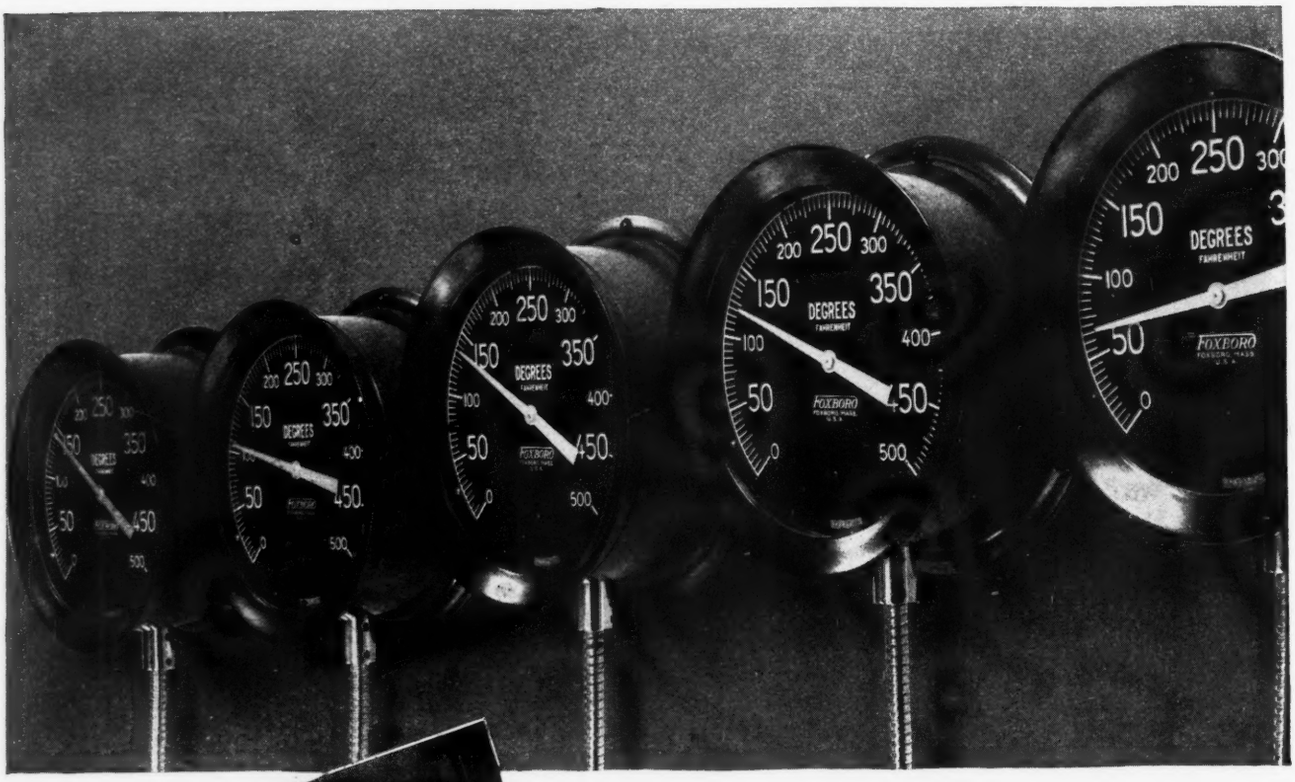
DEARBORN CHEMICAL COMPANY
Dept. D, 310 S. Michigan Avenue, Chicago, Illinois

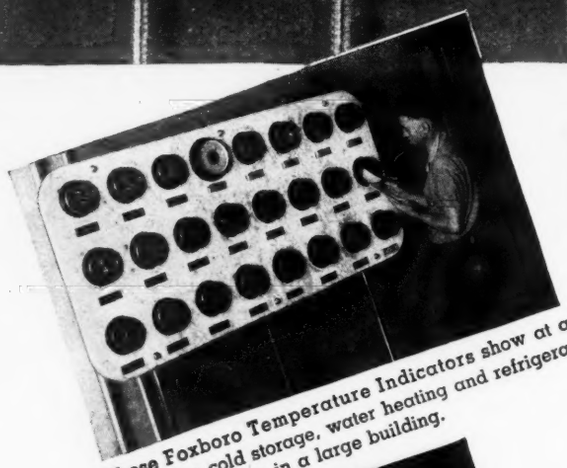
Dearborn Engineer does this for you . . .

(1) *Studies* your water and plant operating conditions.
(2) *Sends* samples of your water to main laboratory for analysis.
(3) *Recommends* proper chemical treatment and chemical control methods.
(4) *Supervises* installation of feeding equipment.
(5) *Instructs* your men on water test methods for treatment dosage adjustment and blow-down control.
(6) *Calls* regularly to insure maintenance of recommended conditions.

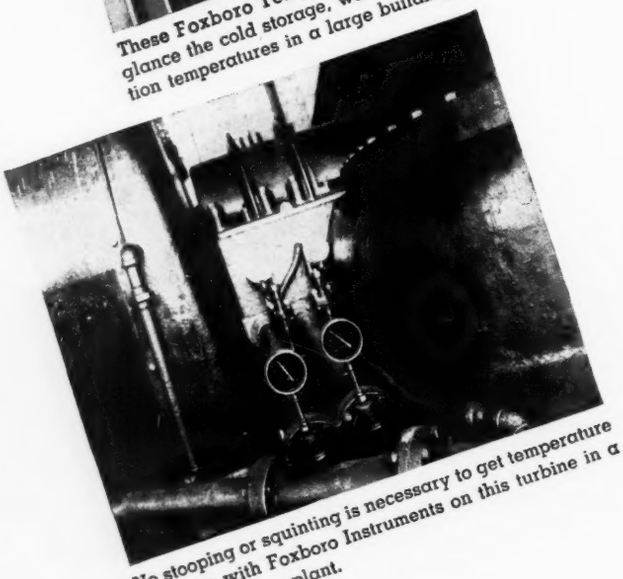
Dearborn

WATER TREATMENT AND ENGINEERING SERVICE





These Foxboro Temperature Indicators show at a glance the cold storage, water heating and refrigeration temperatures in a large building.



No stooping or squinting is necessary to get temperature readings with Foxboro Instruments on this turbine in a mid-west power plant.

They almost SHOUT the temperature!

Important temperatures practically *can't be overlooked,* with Foxboro Temperature Indicators on the "hot spots" of your processes or equipment. These sturdy instruments bring the readings right before your eyes . . . prevent spoilage of precious materials, and safeguard vital equipment!

Foxboro Temperature Indicators can be located in any convenient place up to 200 feet from the bulb. And the clear-cut figures on their airplane-type dials give instant, accurate readings 20 feet away.

Yet easy visibility isn't the only advantage of these accurate instruments. At no higher purchase price, Foxboro Temperature Indicators provide all-metal construction that insures life-time service without maintenance. Write for detailed Bulletin 148-6. **The Foxboro Company, 68 Neponset Ave., Foxboro, Mass., U. S. A.** Branches in principal cities of United States and Canada.

TEMPERATURE INDICATORS BY FOXBORO

Reg. U. S. Pat. Off.

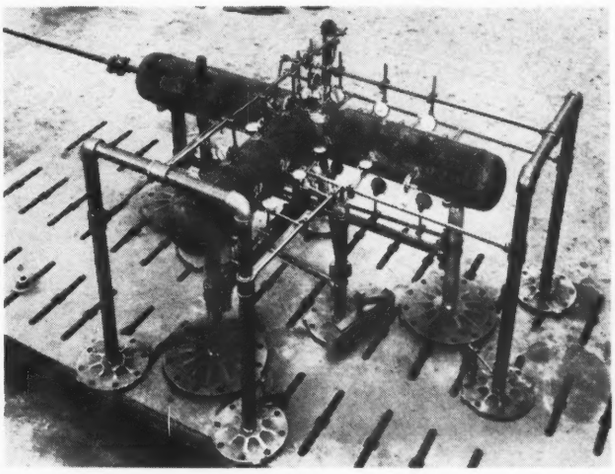
RESEARCH

To Improve Pressure Piping

Representative of the research carried on by qualified pipe fabricators is this study of nozzle reinforcement of welded pipe headers.

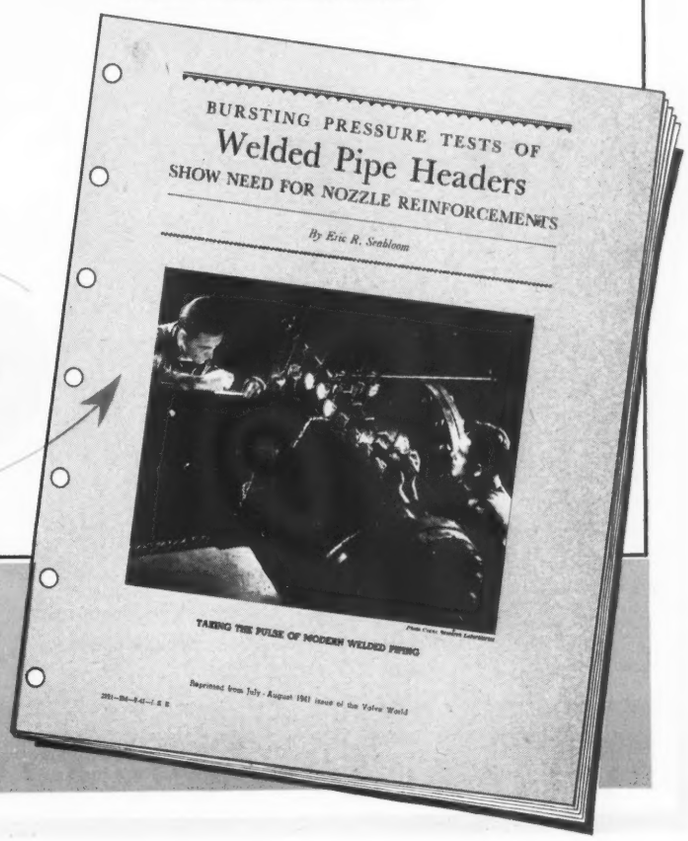
The Pipe Fabrication Institute has for years encouraged and sponsored continuous research into the many and varied problems of pressure piping. The result is improved piping practices and substantial savings to industry.

If you desire a copy of this interesting technical bulletin, simply write to the address below on a business letterhead.



Typical Test Set-up for Headers to Study the Effect of Various Nozzle Constructions

This Report Will Be Mailed Upon Request


BURSTING PRESSURE TESTS OF
Welded Pipe Headers
SHOW NEED FOR NOZZLE REINFORCEMENTS
By Eric R. Stahloom
TAKING THE PULSE OF MODERN WELDED PIPING

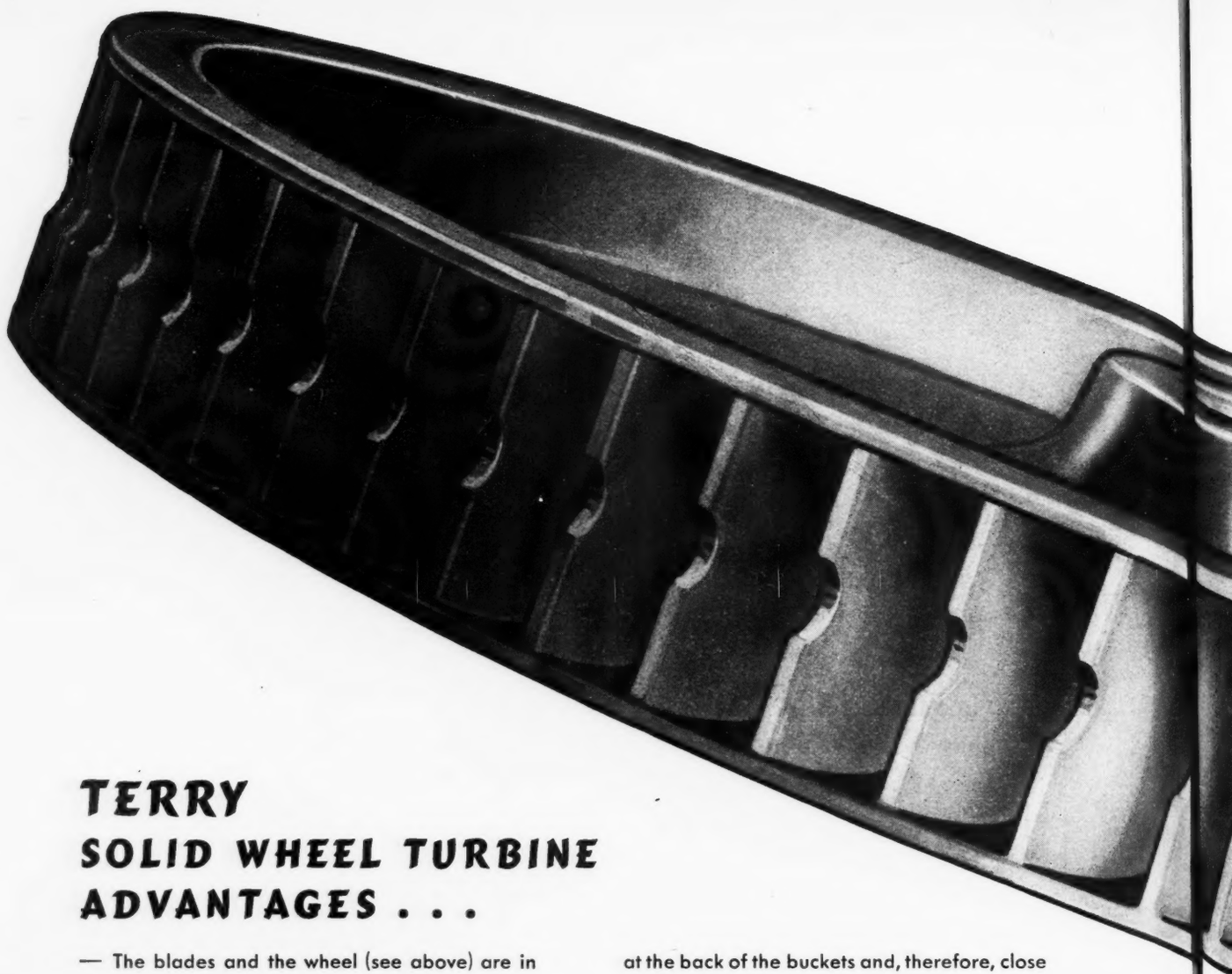
D-8

THE PIPE FABRICATION INSTITUTE

Devoted to the Technical and Economic Problems in Piping

1108 CLARK BUILDING • PITTSBURGH, PA.

The TERRY



TERRY
SOLID WHEEL TURBINE
ADVANTAGES . . .

— The blades and the wheel (see above) are in one piece so that there are no parts to become loose or work out.

— The blades have large clearances.

— The blades are double run protected.

— End play will not damage the blading.

— It is impossible for the blades to foul.

— The power producing action of the steam in the wheel takes place on the curved surfaces at the back of the buckets and, therefore, close blade clearance is not necessary.

— As the only function of the blades is to form a series of pockets, wear of the blade edges is of little consequence and does not materially affect the horsepower or efficiency. The important part of the bucket is the back, or bottom, which is a solid forging.

— The Terry wheel will withstand abuse that would wreck any built up wheel.

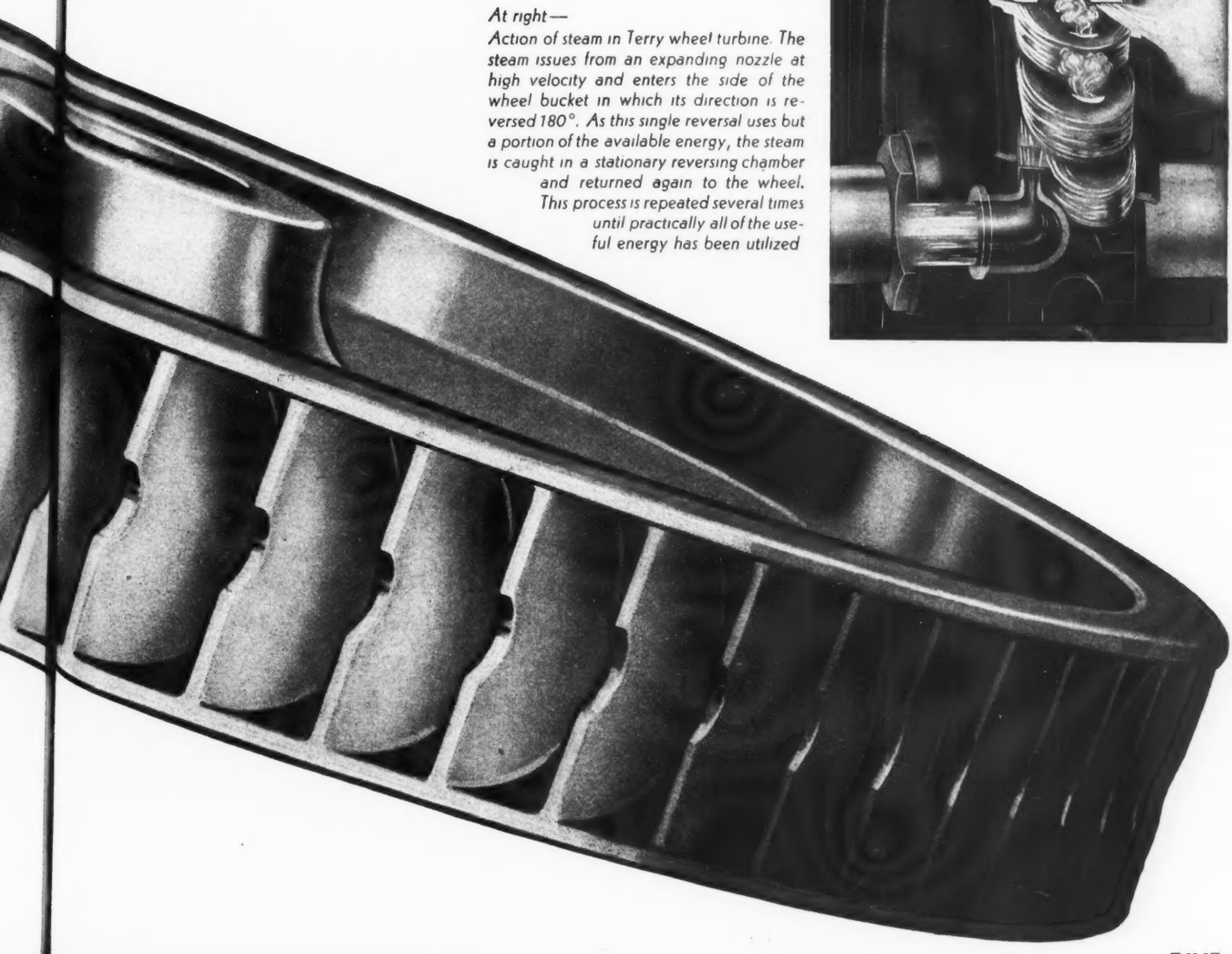
THE TERRY STEAM TURBINE CO.

Wheel Turbine

The Terry Solid Wheel Turbine is available in ratings from 5 HP to 2000 HP. It is built for all commercial steam pressures and exhaust pressures. Thousands of them are in daily service in central stations, industrial plants and on board naval vessels.

Full details of the Terry Solid Wheel Turbine will be gladly sent upon request. Ask for Bulletin S-116.

At right—
Action of steam in Terry wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket in which its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized

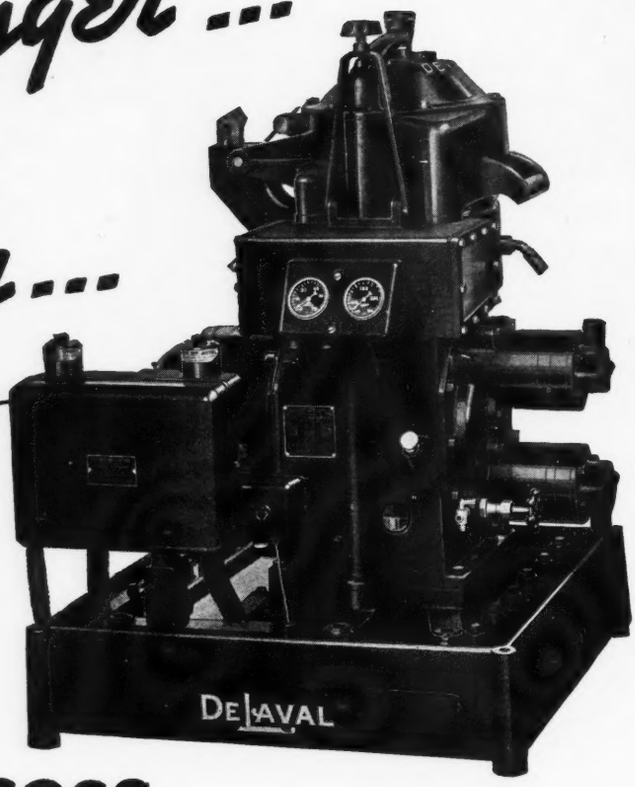


T-1147

TERRY SQUARE - HARTFORD, CONN.

TURBINES ON THE LINE *Longer* ...

MAINTENANCE COSTS *Lower* ...



WHEN LUBRICATING OIL IS CONDITIONED BY THE

DE LAVAL-FUNK Process

The De Laval-Funk Process for maintaining the efficiency of turbine oils makes it possible to meet the demand of the modern turbine for better lubrication, resulting in safer, more continuous and less costly operation.

The De Laval-Funk Process owes its greater efficiency largely to the fact it anticipates how turbine lubricating oil inevitably deteriorates in service and removes the sludge-forming oxidation products *outside* the turbine system—instead of permitting sludge and emulsion to form in the turbine system.

Result: The oil is always in better condition; its life is indefinitely prolonged; there is practically no sludge to coat cooler tubes, prevent proper heat transfer and make frequent cleaning necessary. These are definite results, proved in a large number of plants over a period of many years.

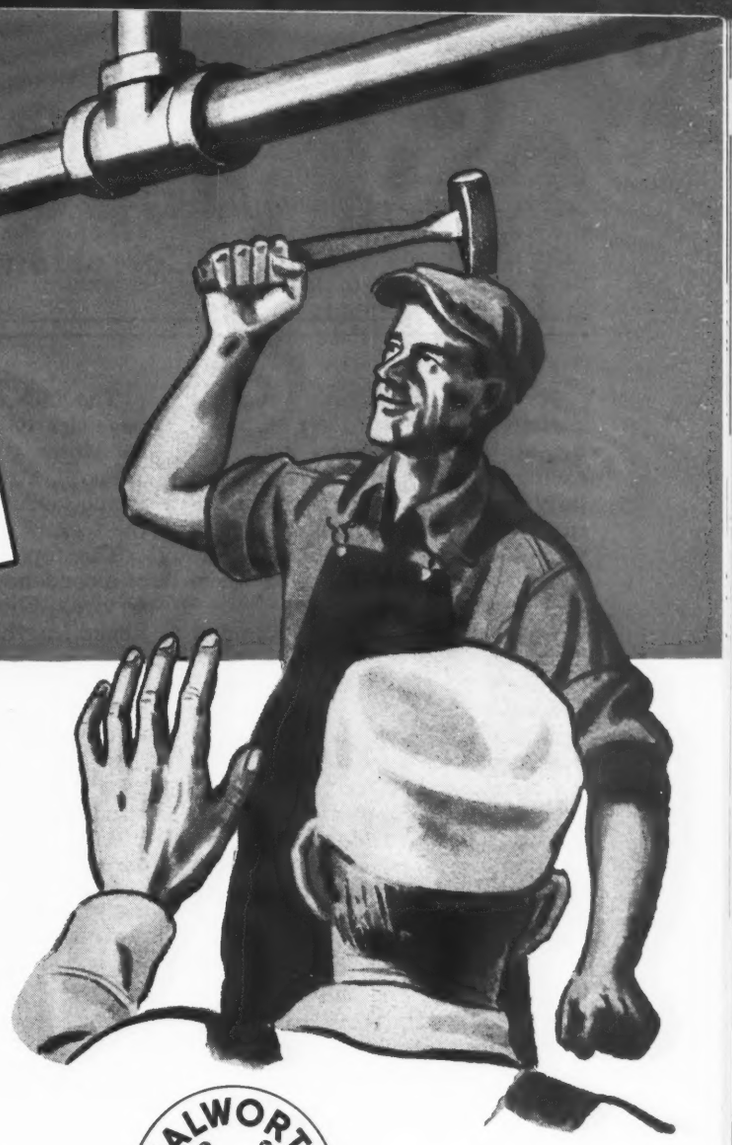
The De Laval-Funk Process can usually be added to existing De Laval systems and is a much superior method of maintaining the efficiency of oil in low-pressure turbines, as well as that used to lubricate newer, high-pressure units. Bulletin No. 106 gives complete details. Why not write for a copy?

DE LAVAL OIL PURIFIERS

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 427 Randolph, St., Chicago
DE LAVAL PACIFIC COMPANY, 61 Beale St., San Francisco
THE DE LAVAL COMPANY, LIMITED
Montreal Peterborough Winnipeg Vancouver

DON'T SMASH THAT FITTING!

METAL'S TOO PRECIOUS TODAY



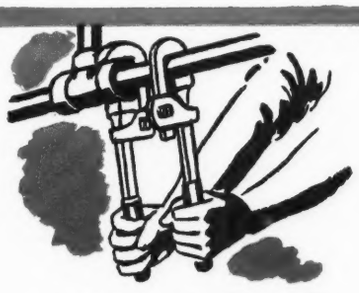
When dismantling or changing a pipeline, remember there still may be useful life in those old cast iron fittings. Take the time to unscrew and examine them instead of breaking them with a hammer. The extra time it takes may save our making and your ordering new fittings. This is especially important now that man hours and metal must be conserved.

It is important to save other products too. Save them by timely and periodic servicing. 15 minutes regrinding, now, may double the useful life of a bronze globe valve. Proper lubrication at regular intervals will mean longer useful life from your Walworth Lubricated Plug Valves.

Another timely factor is Simplification. In cooperation with the U. S. Department of Commerce, National Bureau of Standards, Division of Simplified Practice, there has been developed a Simplified Practice Recommendation R185-42 which covers Grey Cast Iron, Malleable Iron, and Brass or Bronze Pipe Fittings, limiting the sizes which can be manufactured. To this Recommendation Walworth strictly adheres.

WALWORTH 1842 1942 VALVES AND FITTINGS 100TH ANNIVERSARY

Walworth, in its 100th year, is 100% behind the national program of Salvage, Simplification, Specification and Substitution.



1. Unscrew the fitting. Be sure to grip the fitting on the bead, and the pipe as near the fitting as convenient.

2. Inspect the fitting. Pay particular attention to threads. It may be necessary to clean out pipe compound.

3. Reclaimed fittings should be oiled or greased on all threaded surfaces. They are then ready for stock or immediate re-use.

WALWORTH

VALVES FITTINGS and TOOLS
Backed by 100-Years' Service

WALWORTH COMPANY
60 EAST 42nd STREET, NEW YORK

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

Deposit Attack

Local Corrosion Caused by Foreign Matter

It is sound economy, even in normal conditions, to get all possible life from condenser and heat exchanger tubes, but it is particularly important now that uninterrupted power production is so very vital and copper base alloys on the material list to be conserved wherever possible.

Dezincification can be eliminated as a cause of tube failure by the use of Phosphorized Admiralty tubes.

Special alloys are available to resist acidity, high temperature and corrosion caused by velocity.

Corrosion of "deposit-attack" type can be best controlled by close attention to operating conditions.

In many cases, condenser tube life is very seriously impaired by deposits of foreign material which are carried into the tubes by the circulating water and become lodged against the tube wall. An intense local corrosion is frequently observed at points of contact between the tube surface and such foreign matter as stones, shells or other marine growth, cinders, scale, etc. An accelerated corrosion of this type, commonly known as "deposit attack" may reduce the life of condenser tubes from several years to a few months.

Corrosion of tubes from "deposit attack" may result simply in very extensive pitting beneath the deposit — due to a difference in potential between such shielded areas and adjacent areas richer in oxygen. Very often, however, a partial obstruction of the tube by foreign material results in increased velocity of the water, accompanied by turbulence and separation of air at low pressure areas just beyond the obstruction, and leads to severe erosion of the tube wall for some distance from the deposit.

The illustrations on the facing page clearly show what happens to condenser tubes in service when "deposit attack" proceeds at and in the vicinity of an obstruction in the tube.

The top photograph was taken of a condenser tube which failed in service. When this tube was sectioned lengthwise and opened up so that the inside surface of both halves of the tube could be inspected (Figure 1), one section ("A" in the illustration) showed a stone very tightly wedged in the tube and directly opposite this obstruction, the other half of the tube ("B" in the illustration) showed a very tiny perforation of the tube wall (seen in the illustration as a very small white spot). At and in the vicinity of the obstruction (particularly on the down stream side), interruption of the straight line flow of the circulating water with resulting turbulence brought about very severe erosion of the tube wall (seen in the photograph by the roughened irregular areas along the tube length). This is a rather unusual specimen in that the deposit was found intact in the tube after the tube was removed from the condenser; in most cases of this kind, the foreign material is gradually dislodged as corrosion proceeds, and is carried away by the circulating water or loosened and lost during removal of tube from the condenser.

The two halves of a tube, pictured in Figure 2, show an intensely corroded area near the inlet end of the tube. Perforation of the tube wall has occurred at two locations (elongated white areas in the photograph).

This failure is an excellent example of "deposit attack" and its very intense action on the tube. As indicated in the photograph, corrosion of this tube was limited to a relatively small area in the vicinity of the deposit or obstruction while the remainder of the tube surface was not appreciably corroded. This tube actually served less than six months before failure because of a deposit, yet its normal life would have been several years.

Another excellent example of a condenser tube failure resulting from "deposit attack" is shown in Figure 3. This illustration was made of the half section of a condenser tube which included the point of failure; the perforation of the tube wall is identified as a small circular white spot at the intensely corroded area. This failure is very similar to the one illustrated in Figure 2. It is relatively easy to identify the type of tube failure resulting primarily from "deposit attack." It is not so easy to trace the source of such trouble and to take precautionary measures against further damage to tubes from this cause. Attention to certain contributory factors, however is often profitable in preventing or minimizing tube corrosion of the "deposit-attack" type with resultant improved condenser tube life and a corresponding freedom from condenser shut-downs, tube replacements and maintenance expenses.

If your condenser tube corrosion problem can be traced to deposits of foreign material in tubes, the following suggestions are offered for minimizing trouble from this source: —

1. Adequate screening of the circulating water before its entrance into the condenser to make reasonably certain that no foreign material, such as shells, cinders, stones,

Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL
one product . . .
SERVICE IN MANUALS . . .

etc., can pass through or around the screens.

2. A survey of water channels, intake canals, the source of the water supply (such as river, reservoir, bay water, etc.) for any evidence of a filling-in with silt, vegetation, marine growths or other material which would gradually be carried into the condenser and condenser tubes. A cleaning or dredging may be required periodically to eliminate this possible source of trouble.

3. A periodic careful cleaning of condenser tubes, particularly until the source of the trouble is located and corrected. Cleaning should be as often as necessary and as thorough as possible taking care to prevent scoring or otherwise damaging the tube walls.

Individual Study Required

Condenser tube corrosion is an individual problem and most applications require special study. We shall be glad to work with you on any condenser or heat exchanger tube problems you may be facing.

Thus Scovill's service in *men* is combined with its service in *metals* — to bring to the scene of your problem the appropriate results of our engineering research.

A third Scovill service is *manuals*. If we know what your operating conditions are, we can send you literature which will be helpful. Write Scovill Manufacturing Company, 13 Mill Street, Waterbury, Connecticut.

Scovill, for many years a regular source of supply for the U.S. Government, is cooperating in every way to forward defense plans. When deliveries are not as prompt as our customers desire, we hope they will realize that delays are sometimes unavoidable and part of the price paid for national defense.

Fig. 1-A

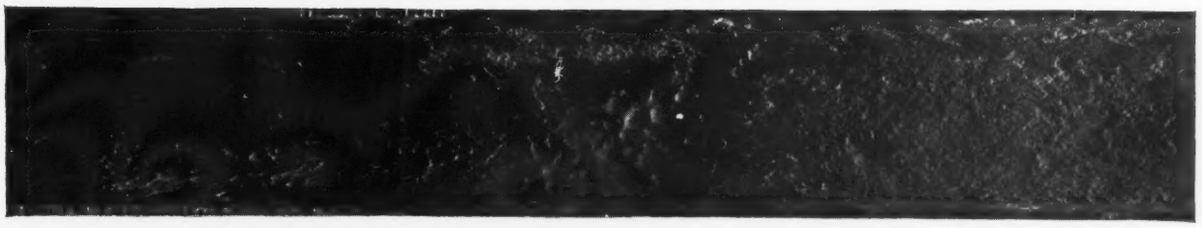


Fig. 1-B

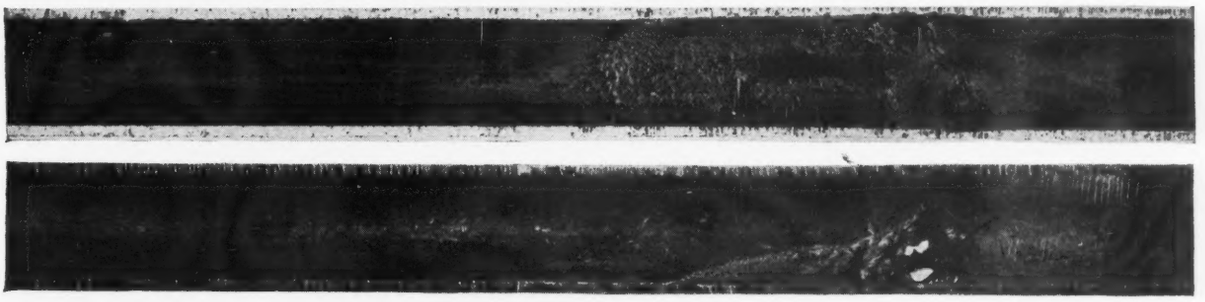


Fig. 2

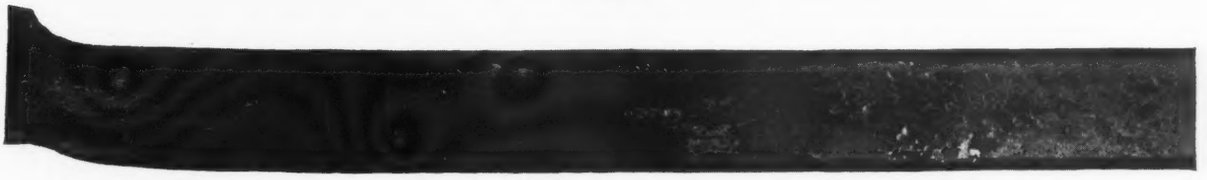
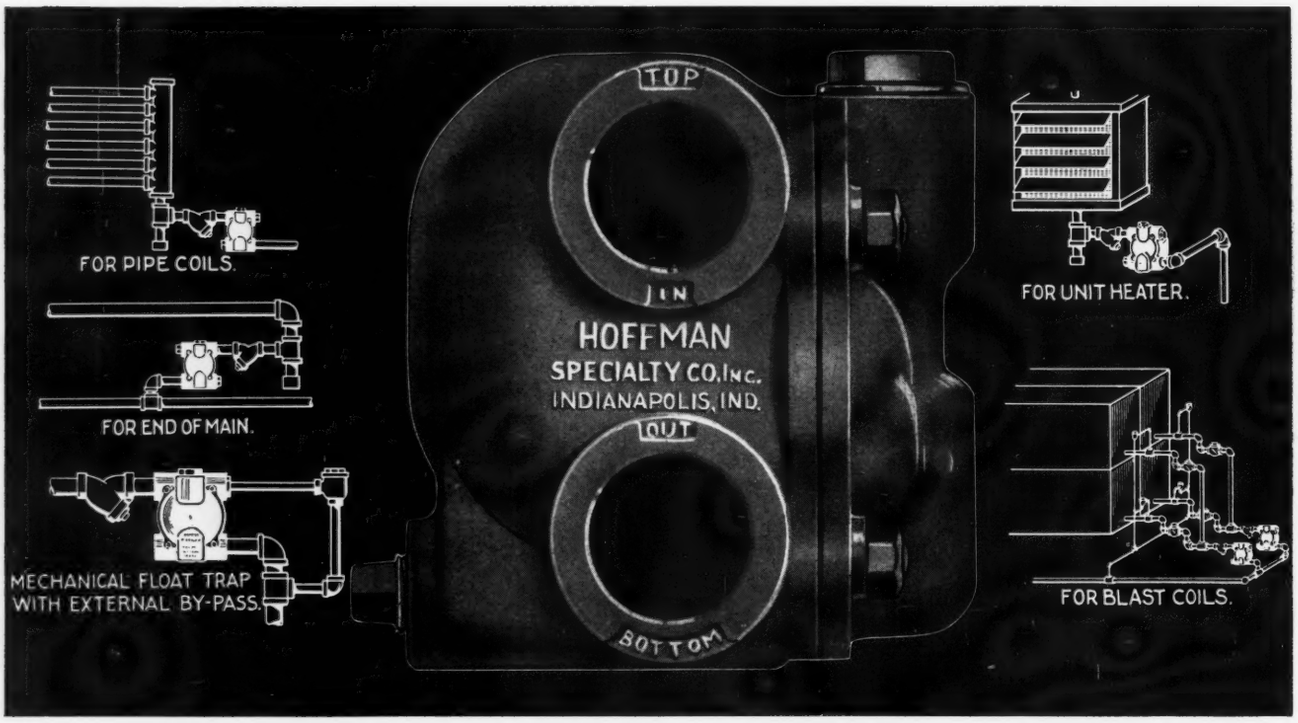


Fig. 3

Condenser Tubes

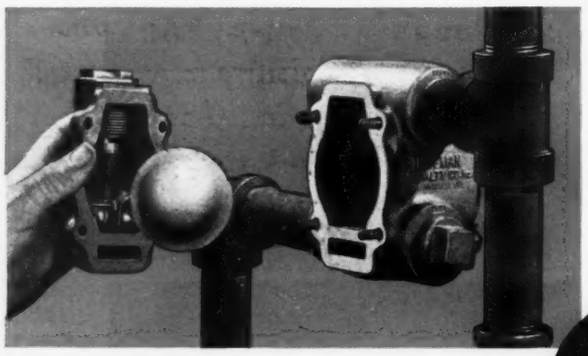
. . . three services

SERVICE IN METALS . . . SERVICE IN MEN



HOFFMAN TRAPS *Save* STEAM

AT EVERY VITAL POINT



Is the steam you're paying for losing punch in the many places where it should be going strongest? Unless your plant is practically new, an examination today may astound you with its revelations of steam loss and wasted fuel.

Prod around for weak spots now—check your traps, your valves and your pumps. What you pay for next winter's fuel depends on what you do *today* in restoring full efficiency to your heating plant.

When you replace equipment—use Hoffman Steam Specialties! Plant engineers for years have depended on them to keep economy records clean . . . not only because of greater *operating efficiency* but because of money-saving *permanence!*

Quality has real meaning when applied to Hoffman Steam Specialties. They are a rare combination of better design and excellent materials, put together with genuine pride in good workmanship. Why else would you find them in so many of the finest installations? Yet with all their merits, Hoffman Specialties *cost no more!*

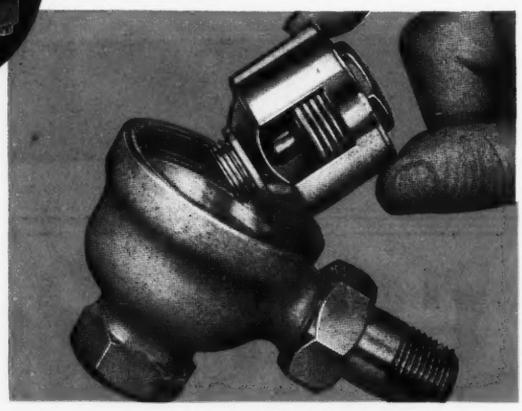
Write for descriptive bulletins on Hoffman Traps, Valves and Pumps.

HOFFMAN 50 SERIES TRAPS

A heavy duty trap for a precision job under toughest conditions. Take the unit apart—see the thirteen features which have won universal approval. Note particularly that all working parts are mounted on the cover—*easily removed for cleaning without breaking pipe connections!* Reversible Valve Pins and Seats for longer life.

HOFFMAN CONDENSATION PUMP

Engineered to amazingly small dimensions without sacrifice of capacity. Vertically mounted motor is high above water and dirt—flexible coupling permits use of standard motor.



HOFFMAN NO. 8A TRAP

Nothing better for radiators and other low pressure jobs. Bellows Thermostat, Valve Pin and Seat are combined in a single, easily removed unit, interchangeable without adjustment—greatly simplifying clean-out and inspection.

HOFFMAN
SPECIALTY CO.

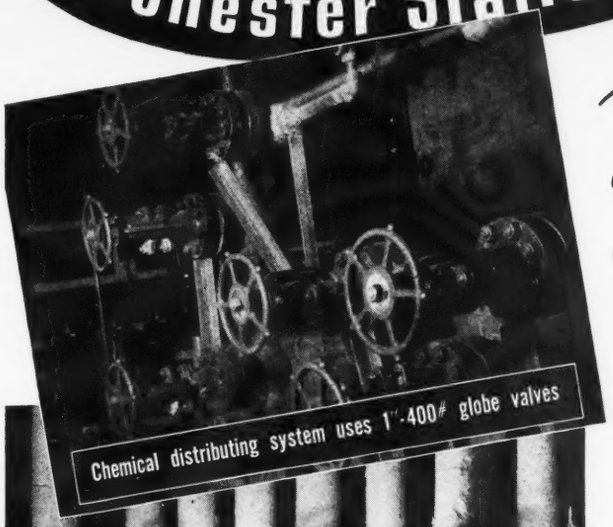
1001 York St., Dept. P-4, Indianapolis, Ind.

Hoffman Steam and Hot Water Specialties are sold everywhere by leading wholesalers of Heating and Plumbing equipment.

STEAM VALVES

on Chester Station's New No.5 Unit!

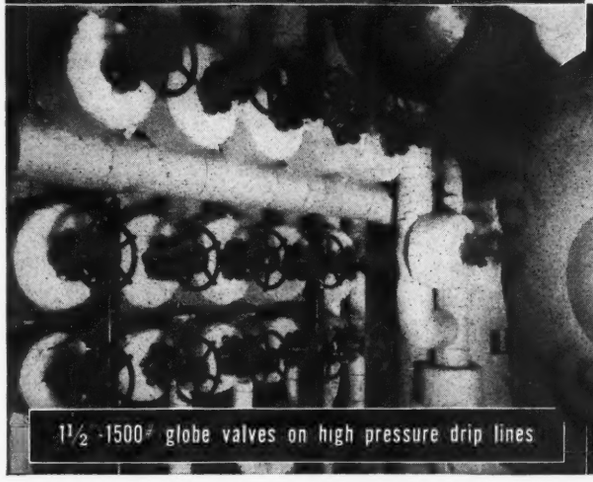
by Vogt



Chemical distributing system uses 1"-400# globe valves

Vogt Steel Valves are d-r-o-p f-o-r-g-e-d and that's why they are extra strong and extra tough . . . operating with a maximum of dependability and a minimum of maintenance in exacting flow control services . . . the kind of performance that is a "must" with power plants like Chester Station of the Philadelphia Electric Company.

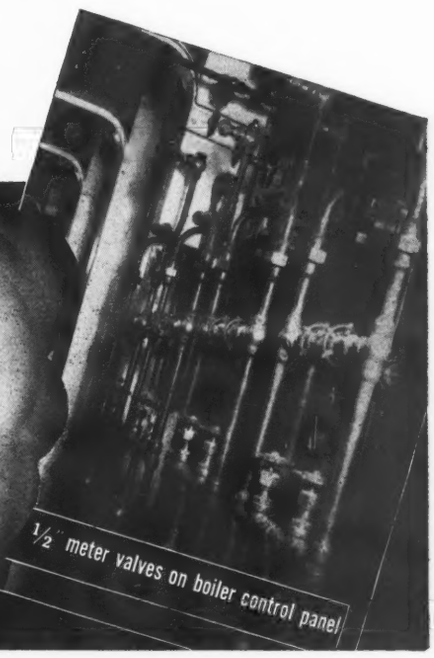
1¼"-600# gate valves on desuperheater manifold



1½"-1500# globe valves on high pressure drip lines

HENRY VOGT MACHINE CO.,
INCORPORATED
LOUISVILLE, KENTUCKY

Branch Offices:
New York, Philadelphia, Cleveland, Chicago, Cincinnati, St. Louis, Dallas



½" meter valves on boiler control panel

LOAD-CENTER DISTRIBUTION

The NEW *and* BETTER *to distribute* ELECTRIC

- **IN INDUSTRIAL PLANTS**
- **IN NAVAL AND MILITARY PROJECTS**
- **IN COMMERCIAL BUILDINGS**

HERE'S the answer to the pressing problem of providing reliable electric power distribution quickly and economically in today's rapidly expanding plants—the LOAD-CENTER distribution system.

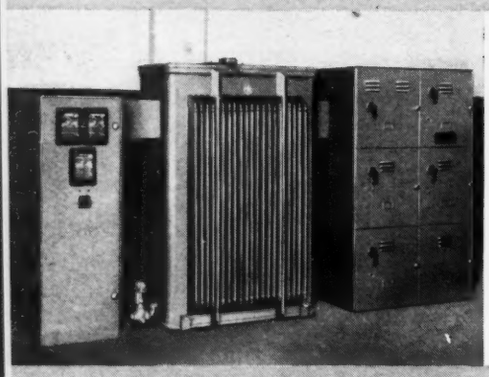
Using load-center power distribution, you can install a *better* distribution system in several weeks less time, at lower over-all cost, and with far less copper and other vital materials than are required for an old-style distribution system. Furthermore, the flexibility of your electric system is increased, engineering and planning time is reduced, and purchasing is considerably simplified.

The system's basic element, the *load-center unit substation* (consisting of a metal-clad incoming-line section, a Pyranol* transformer section, and a low-voltage feeder section with drawout air circuit breakers) is a compact, factory-built, entirely coordinated unit. It's delivered ready to install right in the same room with the machinery to be supplied with power. Thus, you can add substation capacity WHEN you want it and WHERE you need it, largely eliminating the high cost of long, heavy, low-voltage circuits from a distant substation. Voltage drop, too, is greatly reduced, thus improving the performance of your electric equipment.

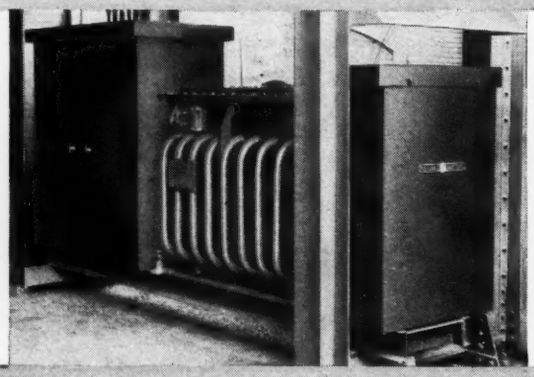
*PYRANOL is G.E.'s trade-mark for a nonsludging, insulating and cooling liquid that will not burn.

SAVES *TIME, MONEY, AND VITAL MATERIALS*

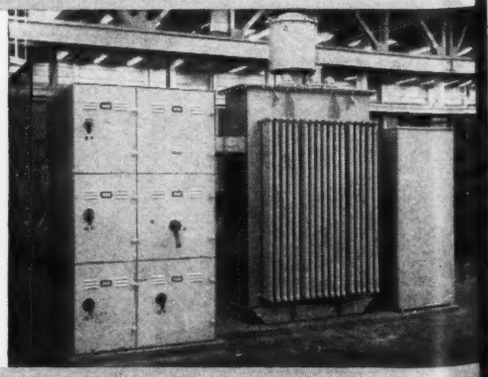
LOAD-CENTER UNIT SUBSTATIONS



Load-center unit substations, basic element of the G-E load-center distribution system, are quickly and easily installed (either indoors or outdoors) at comparatively low cost. And they're entirely metal-enclosed for increased safety.

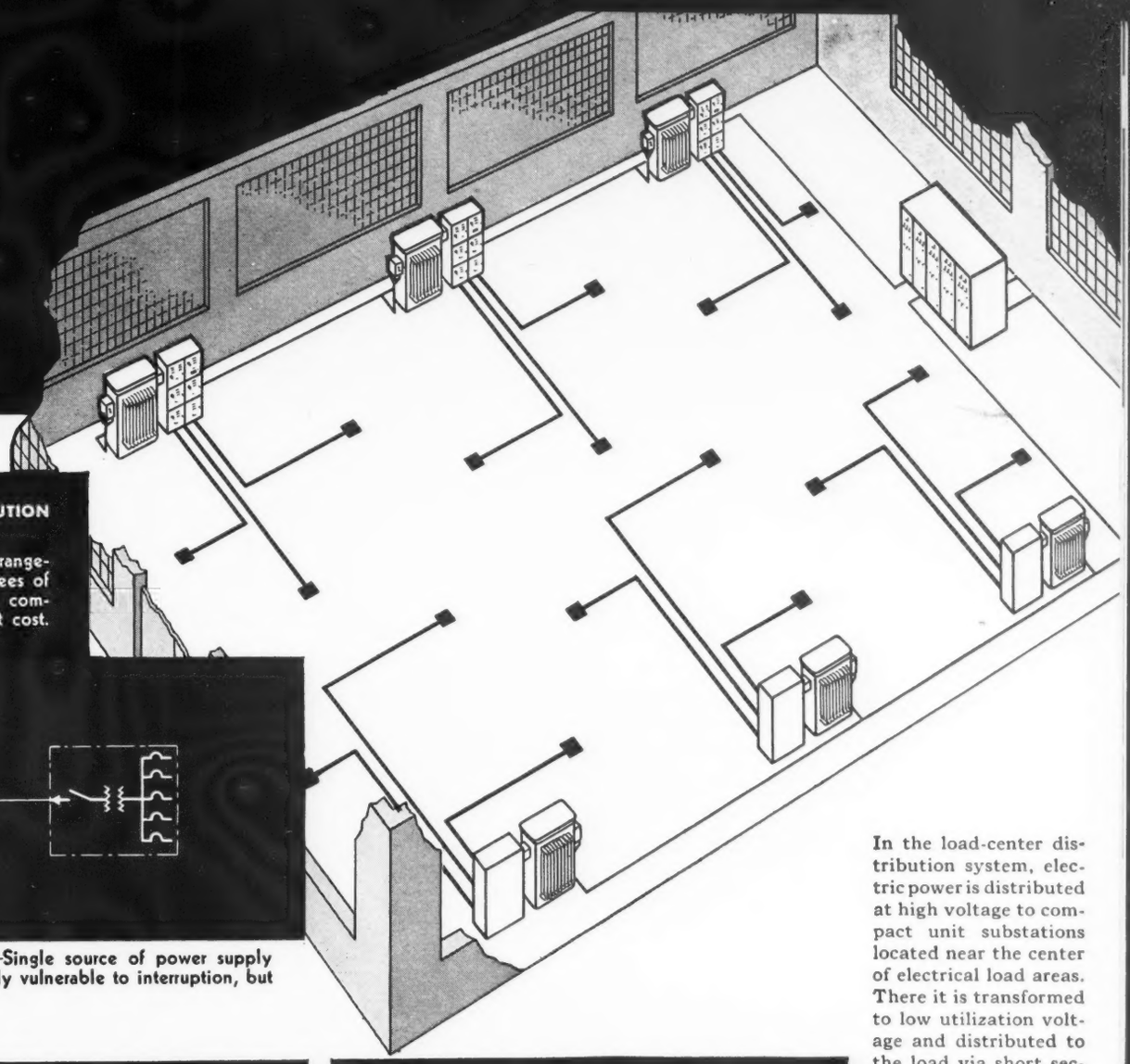


These compact unit substations can be located almost anywhere; this outdoor unit is tucked away beneath a large factory building. As load centers change, units can be easily moved to new locations.



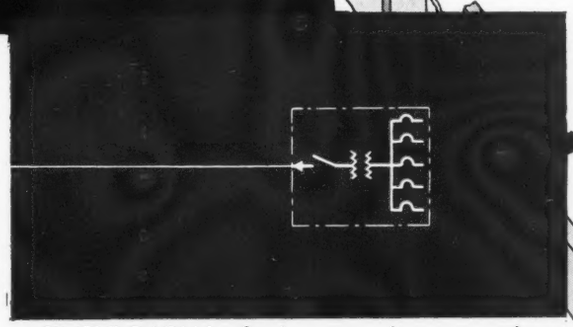
Skid your load-center unit substation into position, make the necessary connections, and it's ready for service. Noninflammable Pyranol means that units can be located right in the same room with machinery without expensive vault construction.

WAY POWER



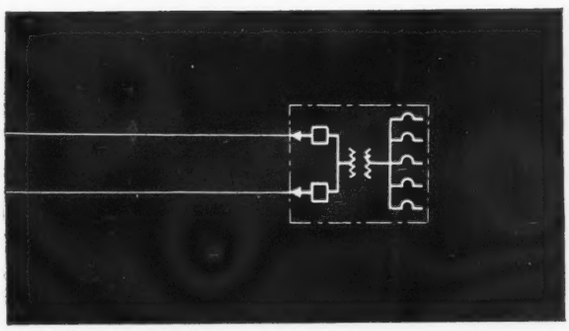
LOAD-CENTER DISTRIBUTION IS FLEXIBLE

Four basic circuit arrangements offer various degrees of service reliability with comparable variations in first cost.

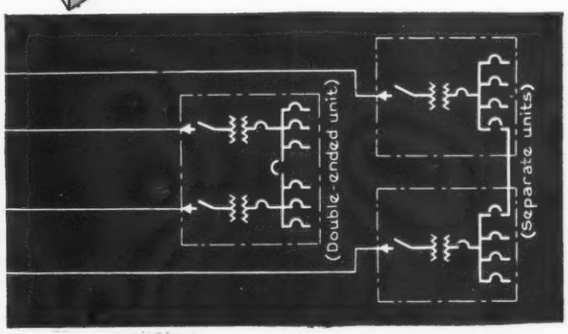


SIMPLE RADIAL—Single source of power supply makes it comparatively vulnerable to interruption, but also least expensive.

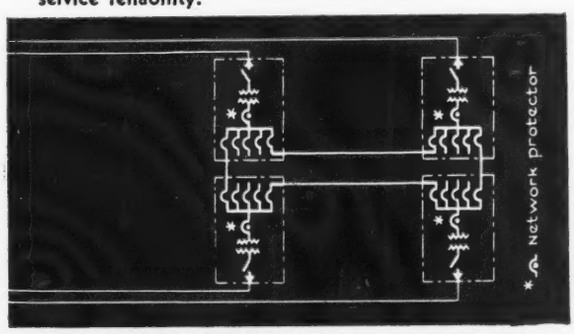
In the load-center distribution system, electric power is distributed at high voltage to compact unit substations located near the center of electrical load areas. There it is transformed to low utilization voltage and distributed to the load via short secondary feeders; thus, you avoid the high cost and voltage drop of long, heavy low-voltage feeders from a distant substation.



PRIMARY SELECTIVE—Two sources of power supply mean an alternate source is available should a fault occur on one primary feeder, thus increasing service reliability.



SECONDARY SELECTIVE—Two sources of supply, interconnected in the secondary, provide an alternate supply in case of an interruption in either a primary feeder or secondary transformer.



SECONDARY NETWORK—Two sources of supply with all transformers operated in parallel on the secondary. A faulty primary feeder or secondary transformer is automatically disconnected. (Highest degree of service reliability.)

General Electric and its employees are proud of the Navy award of Excellence made to its Erie Works for the manufacture of naval ordnance.

FOR THE ENTIRE STORY

General Electric Co., Section A302–1
Schenectady, N. Y.

Send me your Bulletin GEA-3758, "Load-center Power Distribution," which describes in detail how the load-center system saves time, money, and vital materials.

Name.....

Company.....

Address.....

City.....State.....

302-1

GENERAL ELECTRIC

"Easier to Use"

MIDWEST BUTT-WELDING ELBOWS

Welders who have worked on all kinds of piping jobs frequently report that Midwest Welding Elbows are "easier to use" . . . this means an all important saving in time. Layout time is saved because all pipe can be cut in advance according to the drawings . . . time for lining up and tack welding is also reduced.

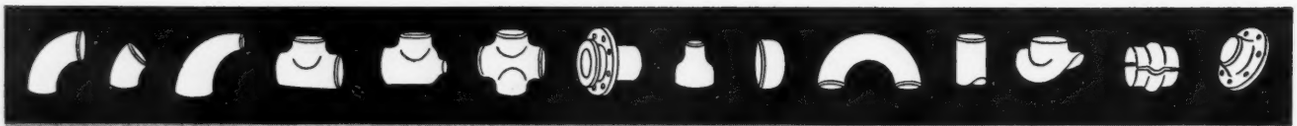
Midwest Butt-Welding Elbows are "easier to use" because of their greater dimensional accuracy and consistent uniformity. These qualities are inherent in Midwest Elbows because of their unique method of manufacture: they are *sized in compression* (not extruded or stretched) and an exact included angle is the result of special fixtures and tools developed by Midwest for machine-beveling the ends.

Bulletin WF-41 shows the other advantages of Midwest Elbows . . . and the complete line of Midwest Welding Fittings. Write for a copy.

MIDWEST PIPING & SUPPLY COMPANY, Inc.

Main Office: 1450 So. Second St., St. Louis, Mo.
Plants: St. Louis, Passaic (N. J.) and Los Angeles

Sales Offices: Chicago—949 Marquette Bldg. • Houston—229 Shell Bldg. Los Angeles—520 Anderson St. • New York—(Eastern Division) 30 Church St. • San Francisco—535 Call Bldg. • Tulsa—533 Mayo Bldg.



MIDWEST WELDING FITTINGS SAVE TIME, IMPROVE THE DESIGN, AND REDUCE THE COST OF PIPING SYSTEMS

TRENCHES

ON THE HOME FRONT

Exide

BATTERIES

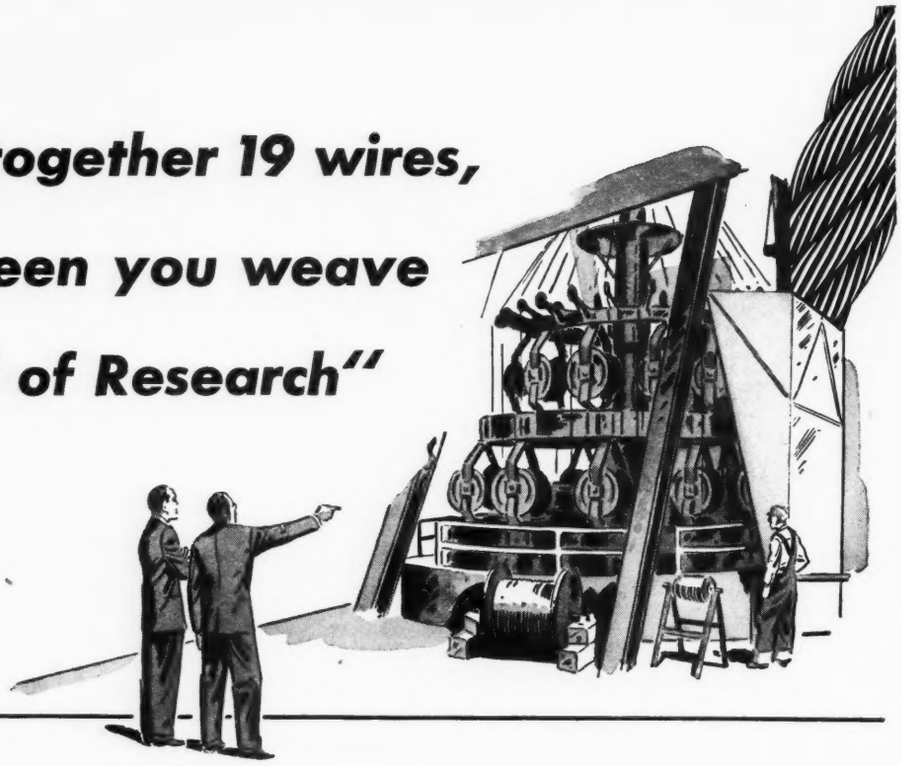
FOR CRANKING DIESEL ENGINES

NOT all heroes reach the headlines. Many work quietly . . . without blaring trumpets . . . and Diesel engines belong in this class. At the battlefront they power tanks. At home, powering some contractor's equipment is just one more job a Diesel does well and at low cost.

Exide Batteries for Diesel-cranking are natural partners to the Diesel engine. Pouring out their great strength at high voltage . . . for faster cranking . . . Exide Batteries have proven their worth in locomotives, tractors, ships, and tanks. Wherever a Diesel is on the job . . . there's an Exide Battery to start its power humming. No Diesel is too large or too small for an Exide.

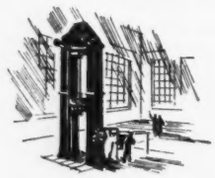
THE ELECTRIC STORAGE BATTERY CO., Philadelphia
The World's Largest Manufacturers of Storage Batteries for Every Purpose
Exide Batteries of Canada, Limited, Toronto

"You strand together 19 wires, and in between you weave the thread of Research"



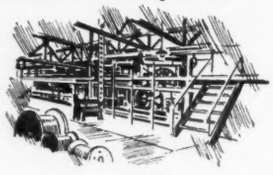
Like the research that's responsible for this giant strander

"Many a job calls for 6 x 19 "Blue Center" Steel Wire Rope, but for those that don't, Roebling Research is ready with specialized facilities and materials. This giant strander, for example, can take as many as 46 tough steel wires, and accurately lay them into strand for pliable, high-strength, large diameter ropes, such as are used on mammoth dredges...



How strong is such a strand? If we want to know, this "tower of torture" will tell us. Another of the long arms of Roebling Research, it can pull apart a 4" wire rope to find its ultimate breaking strength. It also indicates how the rope will behave under *your* conditions and *your* loads...

But of course you know that a study of wire rope quality must cover more than breaking strength alone. That is why Roebling Research created the world's largest, most highly developed fatigue testing machine for wire rope—a giant laboratory in itself. In its 75-foot length it simulates many conditions that "Blue Center" Steel Wire Rope meets in the field, lets Roebling Research men study each condition carefully...



Thus the strong but invisible thread of Research is woven into every inch of Roebling "Blue Center" Steel Wire Rope. Giving it the extra stamina to meet the unusual load as well as the routine one...to give extra service where extra service is called for. Bringing it to the high standards it must pass, to carry the Roebling Trademark..."

JR ROEBLING

Roebling Research, Roebling Engineering, Roebling Plant Facilities and broad Experience... each adds its part to the extra values in Roebling "Blue Center" Rope. Each helps it meet conditions unfailingly, wherever wire rope has a routine or unusual job to do.

JOHN A. ROEBLING'S SONS COMPANY
TRENTON, NEW JERSEY
Branches and Warehouses in Principal Cities

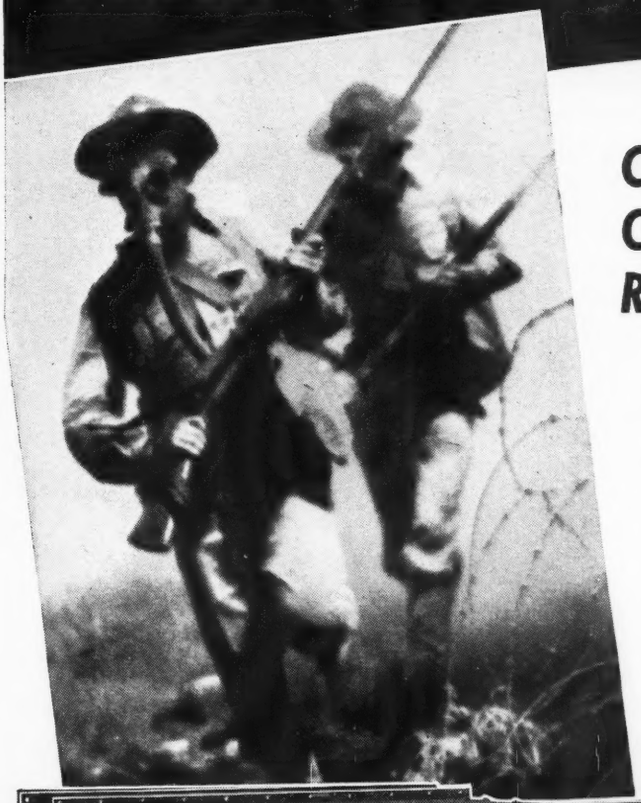
THAT'S THE ONLY WAY TO MAKE

ROEBLING

"Blue Center"

STEEL WIRE ROPE
PREFORMED OR NON-PREFORMED

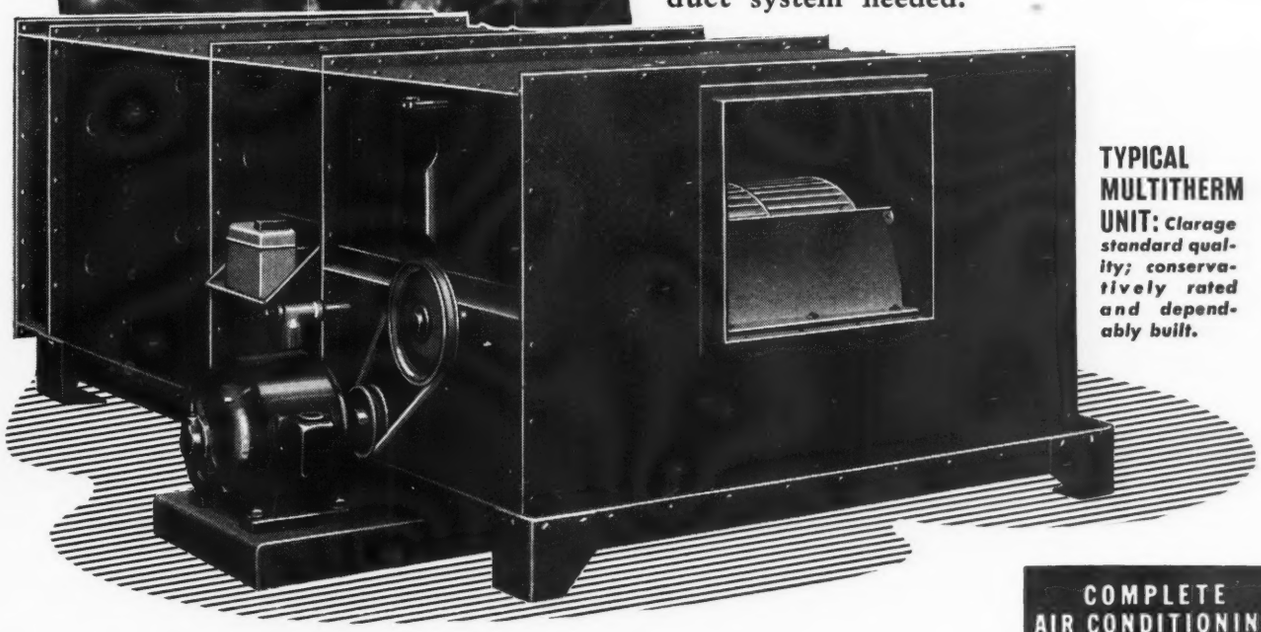
READY—*in Blitzkrieg Time!*



. . . HOW TO MEET *Cooling, Heating, Humidity Control and Air Cleaning Requirements* WITHOUT INSTALLATION DELAYS

Step up your war-time production by maintaining the RIGHT atmospheric conditions in your plant! Using CLARAGE MULTITHERM UNITS the job is reduced to simplest form.

Best of all, **no time lost** getting this equipment into operation. MULTITHERM UNITS can be installed quickly — no building alterations or elaborate duct system needed.



TYPICAL MULTITHERM UNIT: *Clarage standard quality; conservatively rated and dependably built.*

"WHOLE WORKS" in One Compact Assembly

MULTITHERM UNITS are available from Clarage in types to supply cooling only, heating only, or complete, accurate year-round control of temperature and humidity — equipped with filters for air cleaning if desired. Installed like unit heaters — suspended from wall or ceiling, or placed on the floor. Ideal for new war production plants or for plants being converted. *Bulletin 107 gives complete information — write for it!*

COMPLETE AIR CONDITIONING
•
COOLING
•
VENTILATION
•
FACTORY HEATING
•
MECHANICAL DRAFT
•
FANS and BLOWERS for INDUSTRIAL NEEDS

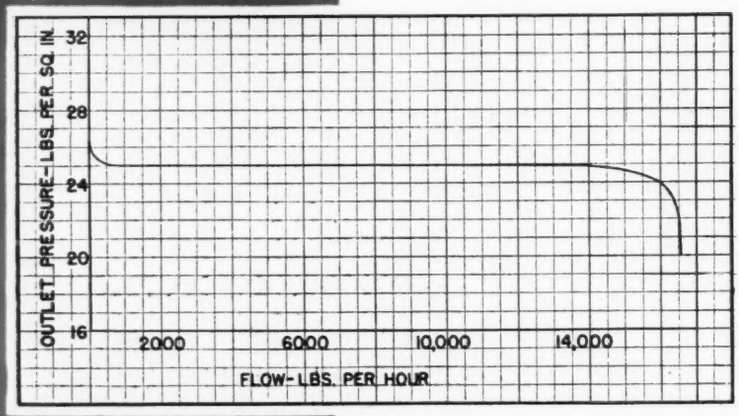
CLARAGE FAN COMPANY—KALAMAZOO, MICH.
SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

TWO OUTSTANDING FEATURES OF THE . . .

FISHER Type 92 REDUCING VALVE FOR STEAM SERVICE

1 CLOSE REGULATION

Maintains extremely accurate control of reduced pressures regardless of fluctuation in upstream pressures and variations in flow.
★ 4" Type 92 actual test curve . . . inlet pressure 100 P.S.I. Reduced pressure 25 P.S.I.



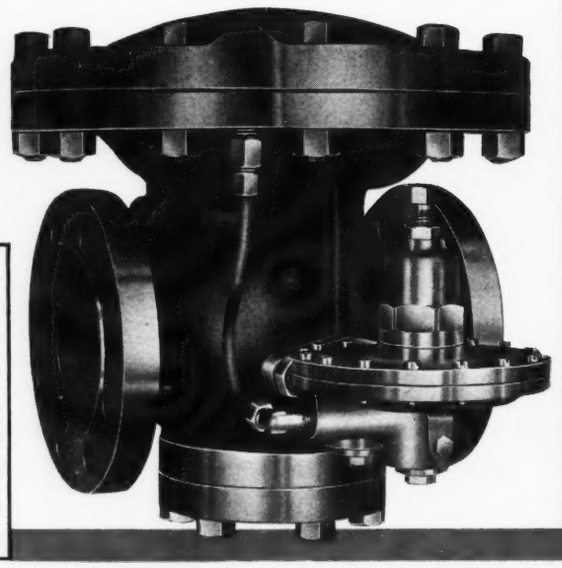
★ Records of Performance quickly show why the Fisher Type 92 has become the logical choice of steam engineers for dependable steam pressure control.

OTHER FEATURES—Two interchangeable pilot valves for high or low pressure service. Tight shut-off for dead end service. Uses steam as operating medium . . . no auxiliary medium required. Extremely compact, requiring minimum installation space. Ribbed construction adds strength to body and diaphragm casings. All parts including pilot strainer, readily accessible for cleaning. Wide range of springs for various pressure conditions. Write today for Bulletin C1!

2 LARGE CAPACITY

Unusually large capacity effects savings in initial cost by permitting use of smaller valves. Compare these capacities with valves of similar type.
★ Capacities in pounds of saturated steam per hour. Capacities for other pressure conditions correspondingly large.

INLET	REDUCED	PIPE SIZES, INCHES									
PRESS.	PRESS.	½	¾	1	1¼	1½	2	2½	3	4	6
250	100	1357	2530	4350	5650	8150	13420	19800	27500	38800	62900
200	80	1100	2050	3540	4560	6550	11000	15700	22500	31300	51500
150	60	825	1560	2710	3620	5110	8300	12300	16800	23800	40250
100	40	562	1080	1875	2480	3500	5930	8660	11800	16500	27400
75	20	446	857	1450	1900	2720	4770	6700	9290	11320	21350
50	10	321	608	1030	1370	1890	3390	4780	6650	9110	15600
25	10	170	338	540	755	1080	2080	3020	3850	5000	8800



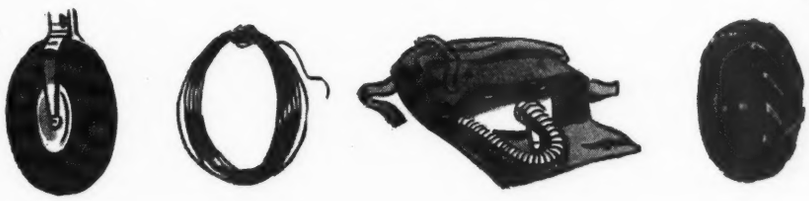
FISHER GOVERNOR COMPANY
• 419 FISHER BUILDING •
MARSHALLTOWN, IOWA

[Another advertisement telling how different American industries are speeding up wartime production]

We've got to stretch it

TO WIN THE WAR

Taylor Instruments are helping fill America's wartime rubber needs



AMERICA needs rubber enough to go round. We've got to stretch our national stock of rubber, because the war has already cut us off from 97% of our normal rubber supply. We need rubber to fight this modern war.

To make sure we get it, America's great rubber industry is relying on Taylor temperature and pressure control instruments to do the vast job faster and better. Taylor Instruments insure precision exactness—automatically safeguard complicated operations—speed up the whole involved process. They are vital necessities to our wartime rubber program.

Here's some war work Taylor Instruments are doing. They help produce:

BETTER NATURAL RUBBER . . .

Within the next few months, production of U. S. Signal Corps assault wire will be stepped up 300%. This latex-covered copper wire, so fine that one man can carry ¾ of a mile of it, is used to lay battlefront communication lines. It must be tough, sturdy, micrometer-exact in size, 100% reliable. It is cured by specially designed equipment completely controlled by Taylor Instruments.

Bomber tires, like the 8-foot, 1000-pound giants on the 82-ton Douglas B-19 planes, have to be cured precisely right to stand the terrific impact of landing. They are now out of the experimental stage, in full production. Taylor coordinated control systems govern the exact curing process that gives them strength.

Gas mask production has jumped to millions of masks per year. The face-covering part, molded in one piece, can now be produced on a 24-hour schedule with the help of Taylor Flex-O-Timers to control the sequence of operations.

Rubber-lined, leak-proof gas tanks for planes, scarcely known a few months ago, are now produced by thousands. Taylor Instruments are steadily being added to help increase this mounting output.

BETTER SYNTHETIC RUBBER . . .

A large part of all synthetic rubber production is controlled by Taylor Instruments. Fact is, synthetic rubber could not be produced without the close control insured by such instruments. The first synthetic "pilot plants" were Taylor-equipped—the tremendous commercial plants use Taylor Instruments. They will help boost synthetic rubber production from 40,000 tons last year to the 600,000-ton yearly total America must achieve.

BETTER "RECLAIM" RUBBER . . .

The production of "reclaim" rubber has almost doubled—skyrocketing from 200,000 to 350,000 tons annually in two years. It will keep on rising, because Taylor Instruments help assure the exact time and temperature schedules of "reclaim" de-vulcanizing processes.

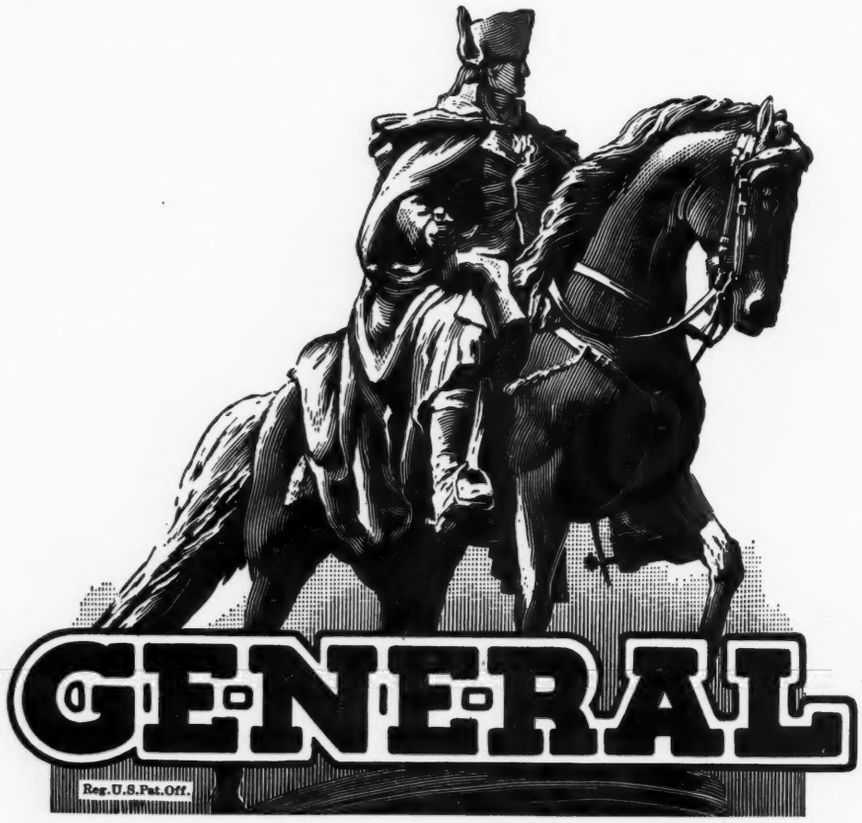
With the help of Taylor Instruments, *every* American industry can be geared to the "go" that will win the war. Taylor Instruments will help *you* produce more, produce better, save time, and save manpower. All through industry, Taylor Instruments have given faithful service for years. Depend on them in these war times. Depend on the "know how" of Taylor engineers to show you how to squeeze the last vital ounce of efficiency from your existing production equipment. Your country needs *producers*—that's why *you* need Taylor Instruments. Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada. Makers of the famous "Not 1 but 5" Fulscope Controllers.

★ **KEEP ON BUYING U. S. DEFENSE BONDS AND STAMPS** ★

Taylor

Indicating / Recording Controlling

TEMPERATURE, PRESSURE, FLOW *and* LEVEL INSTRUMENTS



RODA — High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

DENDRON — High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA — High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

PREMIX STOKER — A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

COKE — Roda and Stonega from Wise County, Va., and Connellsville Coke from Pennsylvania.

CRITERION COAL — High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

CROZER — Genuine Third Vein Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railroad.

Admiralty Coal — Genuine New River Smokeless, Beckley or Sewall seam from Raleigh County, W. Va.. C. & O. and Virginian Railroads.

Old Kentucky — Hazard No. 4 and No. 7 steam and domestic coal from Wiscoal, Knott County, Kentucky, on the L. & N. Railroad.

GENCO — Steam and domestic coals from a number of producing districts.

ANTHRACITE — Premium and standard qualities in the entire range of Anthracite burning characteristics.

Capable engineering personnel and the experience gained through long and varied marketing activity assures proper application of one of the above brands and effective servicing of any fuel requirement.

General Coal Company

123 SOUTH BROAD STREET — **PHILADELPHIA, PA.**

Branches

BLUEFIELD, W. VA.
BOSTON
BUFFALO
CHARLESTON
CHARLOTTE, N. C.
CINCINNATI
DETROIT
NEW YORK
NORFOLK
PITTSBURGH

THERE'S ONLY ONE LOGICAL ANSWER TO THE QUESTION

HOW LONG WILL A PUMP LAST?

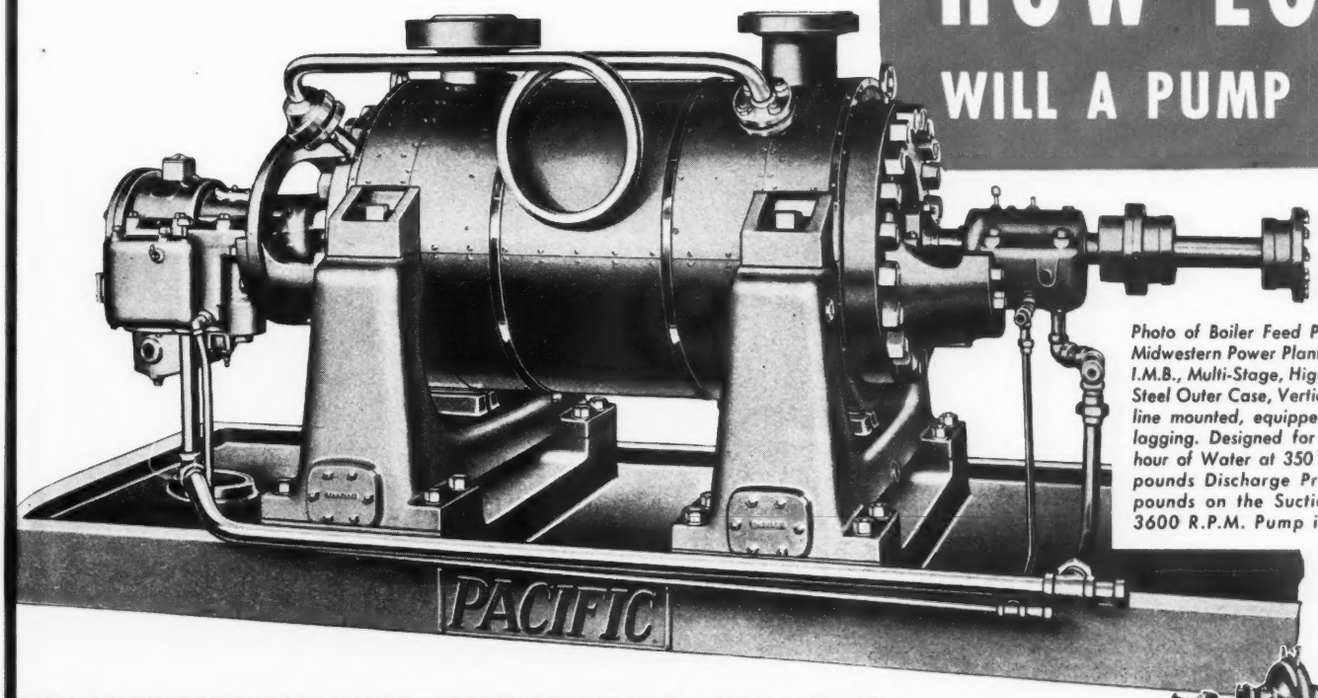


Photo of Boiler Feed Pump operating in Midwestern Power Plant. "PACIFIC," Type I.M.B., Multi-Stage, High Pressure, Forged Steel Outer Case, Vertically Split, Centerline mounted, equipped with removable lagging. Designed for 500,000 lbs. per hour of Water at 350° F., against 1600 pounds Discharge Pressure, with 350 pounds on the Suction, operating at 3600 R.P.M. Pump is Motor Driven.

SERVICE RECORDS TELL THE STORY!

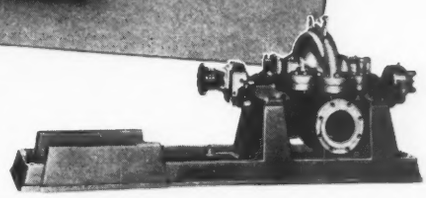


Photo of Boiler Feed Pump operating in Standard Oil Company of California, Refinery. "PACIFIC," Type K.H.T.B., Single-Stage, Double Suction, Horizontally Split, Centerline mounted, Pump. Designed for 1200 G.P.M., of Water at 210° F., against 210 pounds Discharge Pressure, operating at 3000 R.P.M. Pump is Steam Turbine Driven.

There is only one intelligent way to gauge length of pump life—that is to check records of service in actual operation. Satisfied purchasers have long been Pacific's best salesmen. There isn't a Pacific Centrifugal Pump installation where we hesitate to give the user's name as reference or to suggest that you check up performance and service records with them.

Pacific Pumps are performing consistently and economically in plants the world over. A reflection of their reliability lies in the steadily increasing number of Pacific installations.

Write today for copies of bulletins describing various types of Pacific Centrifugal Pumps.

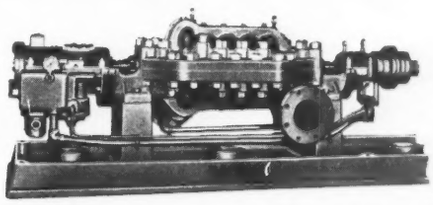


Photo of Boiler Feed Pump operating in City of Glendale, California, Power Plant. "PACIFIC," Type J.H.M.B., 5-Stage, High Pressure, Horizontally Split, Centerline mounted. Designed for 609 G.P.M. of Water at 300° F., against 788 pounds Discharge Pressure, operating at 3600 R.P.M. Pump is Motor Driven.

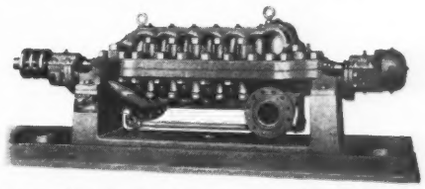
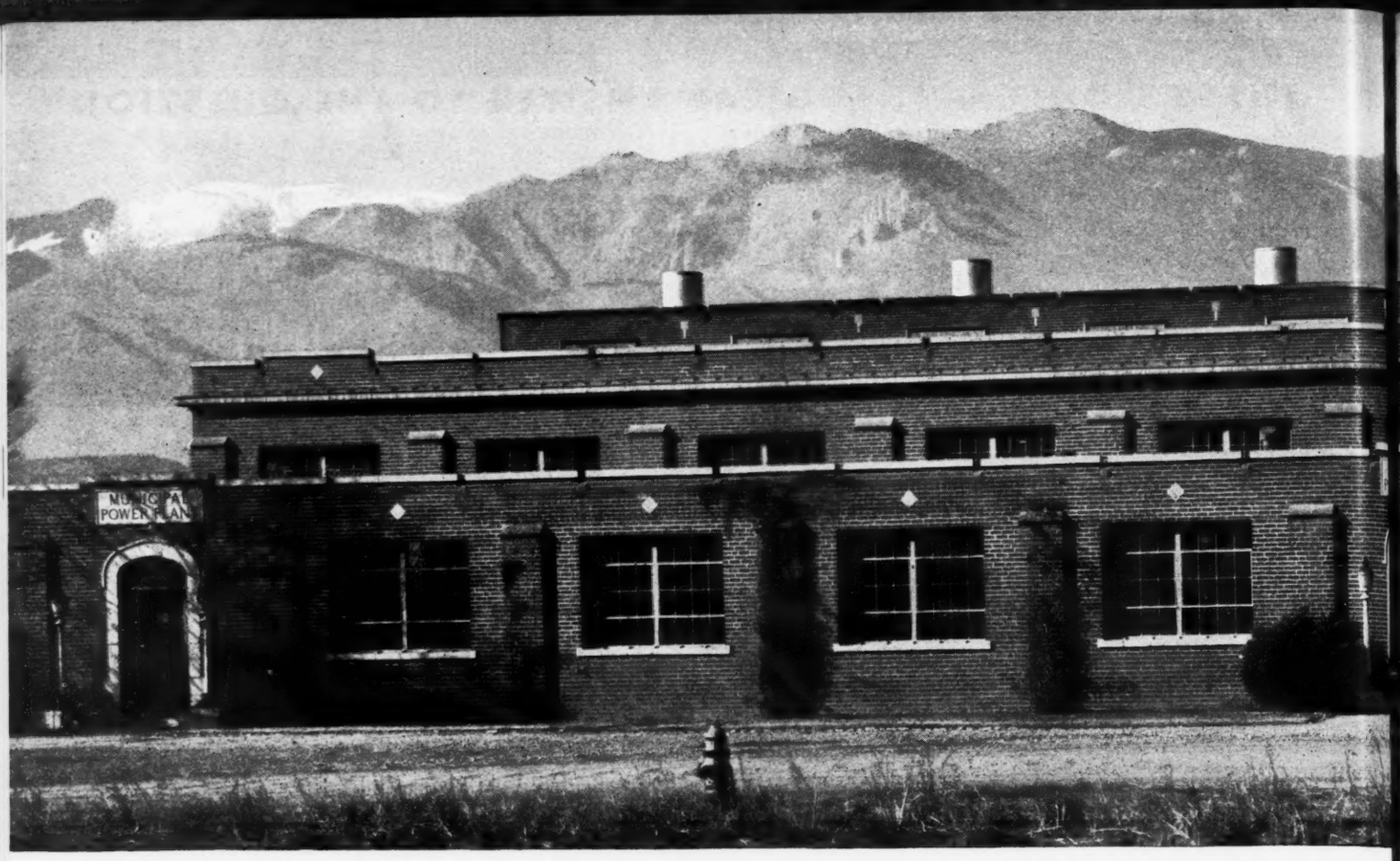


Photo of Boiler Feed Pump operating in City of Pasadena, Power Plant. "PACIFIC," Type P.M.B., 7-Stage, High Pressure, Horizontally Split, Centerline mounted, Pump. Designed for 790 G.P.M., of Water at 240° F., against 543 pounds Discharge Pressure, operating at 1800 R.P.M. Pump is Motor Driven.

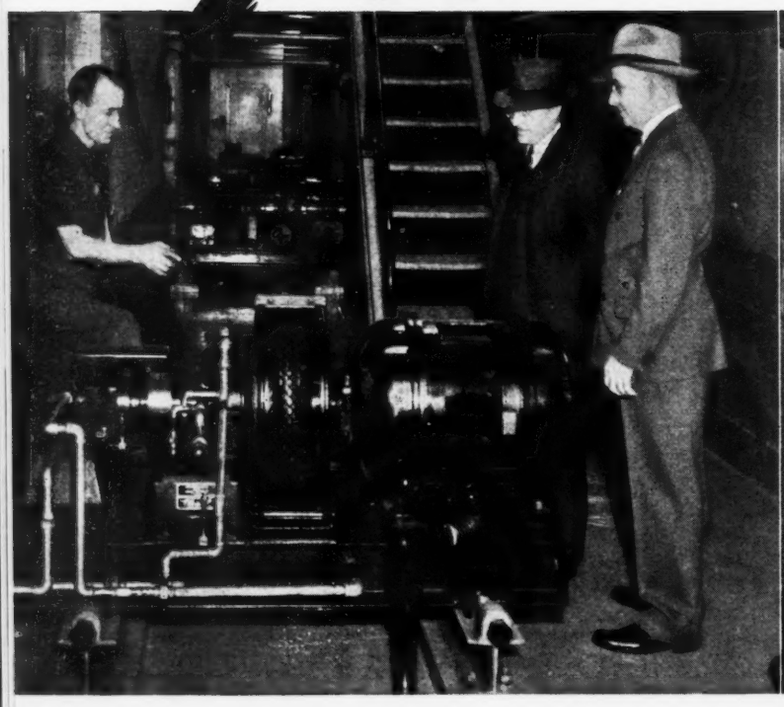
PACIFIC PUMP WORKS

Executive Offices and Plant: Huntington Park, California • *Export Office:* 30 Rockefeller Plaza, New York
Sales and Service: Offices in Principal Cities in the United States • *Affiliated Companies:* Clark Bros. Co., Olean, N. Y., Manufacturers of Engines and Compressors; Dresser Manufacturing Co., Bradford, Pa., Manufacturers of Pipe Couplings, Sleeves, etc.; The Bryant Heater Co., Cleveland, Ohio, Manufacturers of Heating and Air Conditioning Equipment.

PACIFIC *Engineered* PUMPS

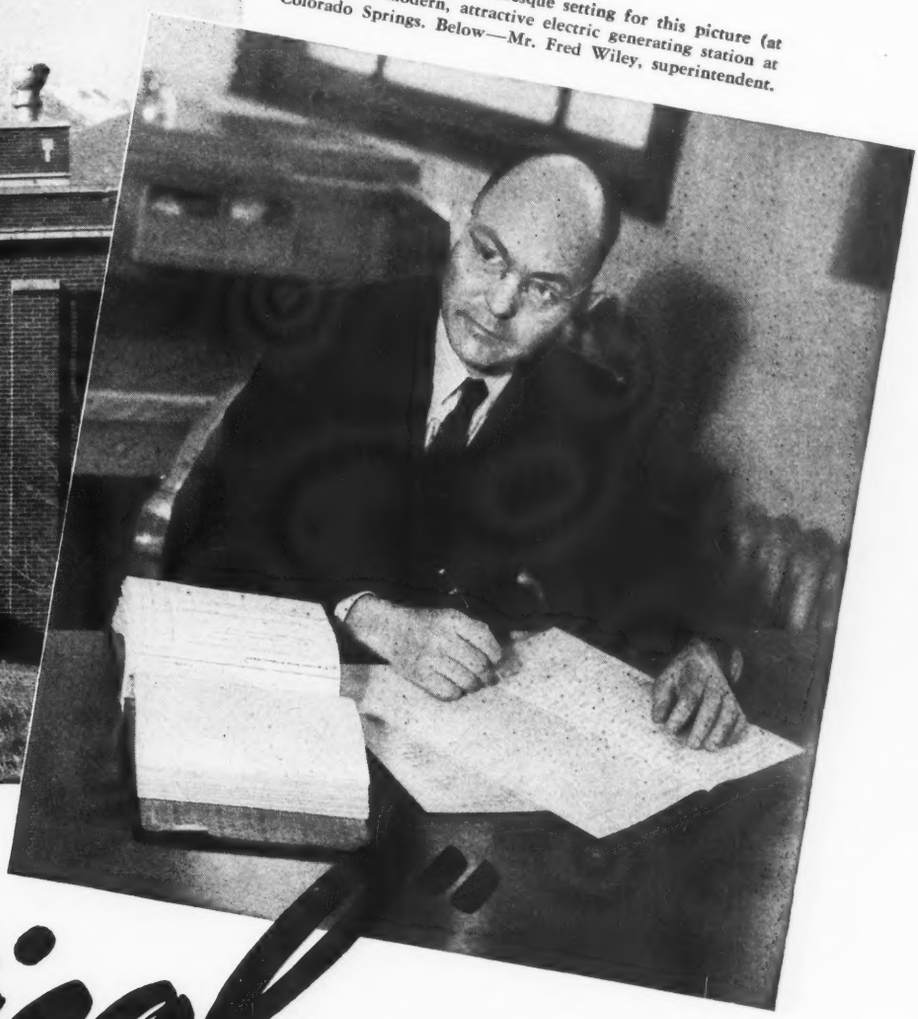


"Our early experience proved Fluid Drive"



Mr. Bill Whelan, chief engineer (shown at left) and Mr. Fred Wiley, superintendent (center) take the interviewer (right) on a tour of the Colorado Springs power plant. In foreground is the first belt American Blower Fluid Drive installed. The two most recently installed Fluid Drives are shown in background.

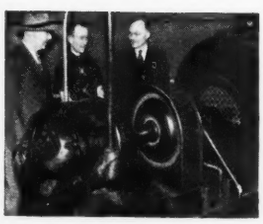
Mr. Whelan, who, like Mr. Wiley, is in a position to know, is well satisfied with the performance of this American Blower Fluid Drive, installed with an American Blower Induced Draft Fan. "The fact that we can use the simple, rugged type of motor is one of the things we like about Fluid Drive," Mr. Whelan (left) tells the interviewer.



Pike's Peak forms a picturesque setting for this picture (at left) of the modern, attractive electric generating station at Colorado Springs. Below—Mr. Fred Wiley, superintendent.

Practical

SAYS F. H. WILEY, SUPERINTENDENT



"Our plant is now 100% Fluid Drive (Hydraulic Coupling) equipped," says F. H. Wiley, power plant superintendent of Colorado Springs, Colorado. "This expresses our opinion of them better than any other statement we could make. Since our purchase of the first two in 1932, we have replaced our three older fan drives with American Blower Fluid Drives, and now have on order two more for our latest boiler addition. We are proud of having had a part in pioneering Fluid Drives for power plant fan drive in this country. We know, by actual experience, that Fluid Drive improves overall plant efficiency."

We of American Blower are proud, too, that we have been privileged to supply not only Fluid Drives, but Forced and Induced Draft Fans for the modern electric generating station at Colorado Springs. In other fine power plants, too, serving communities large and small throughout the land, you'll find these time-proved products giving dependable service, year in and year out. If you have any problem involving Fluid Drive, Mechanical Draft or Dust Precipitator equipment, phone or write the nearest American Blower branch office today.

MECH. DRAFT · AIR CONDITIONING
AMERICAN BLOWER
FLUID DRIVES · DUST COLLECTORS

AMERICAN BLOWER

HYDRAULIC COUPLING DIVISION, DETROIT, MICHIGAN

DIVISION OF AMERICAN RADIATOR AND STANDARD SANITARY CORP.

IN WAR AS IN PEACE -

There are more SLOAN FLUSH VALVES *sold than all other makes combined!*

The pre-eminence of the Sloan Valve Company, founded in times of peace, has earned for us the tremendous responsibility of meeting the demands of war-time production for the vast majority of all of America's defense arsenals. Today, as always, the Sloan Valve Company is producing more Flush Valves than all other makers combined.

Why SLOAN FLUSH VALVES?

★ ***THEY SAVE WATER.*** Because of the accuracy and permanence of adjustment Sloan Valves save their owners water *all* of the time. And saved water is saved money—not only in reduced consumption of water but in reduced pumping and man-power costs.

★ ***THEY REDUCE MAINTENANCE COSTS.*** Sloan Flush Valves cost but ½¢ to 1½¢ per valve per year to maintain. Entire installations, in service for years without being touched, are constantly being reported.

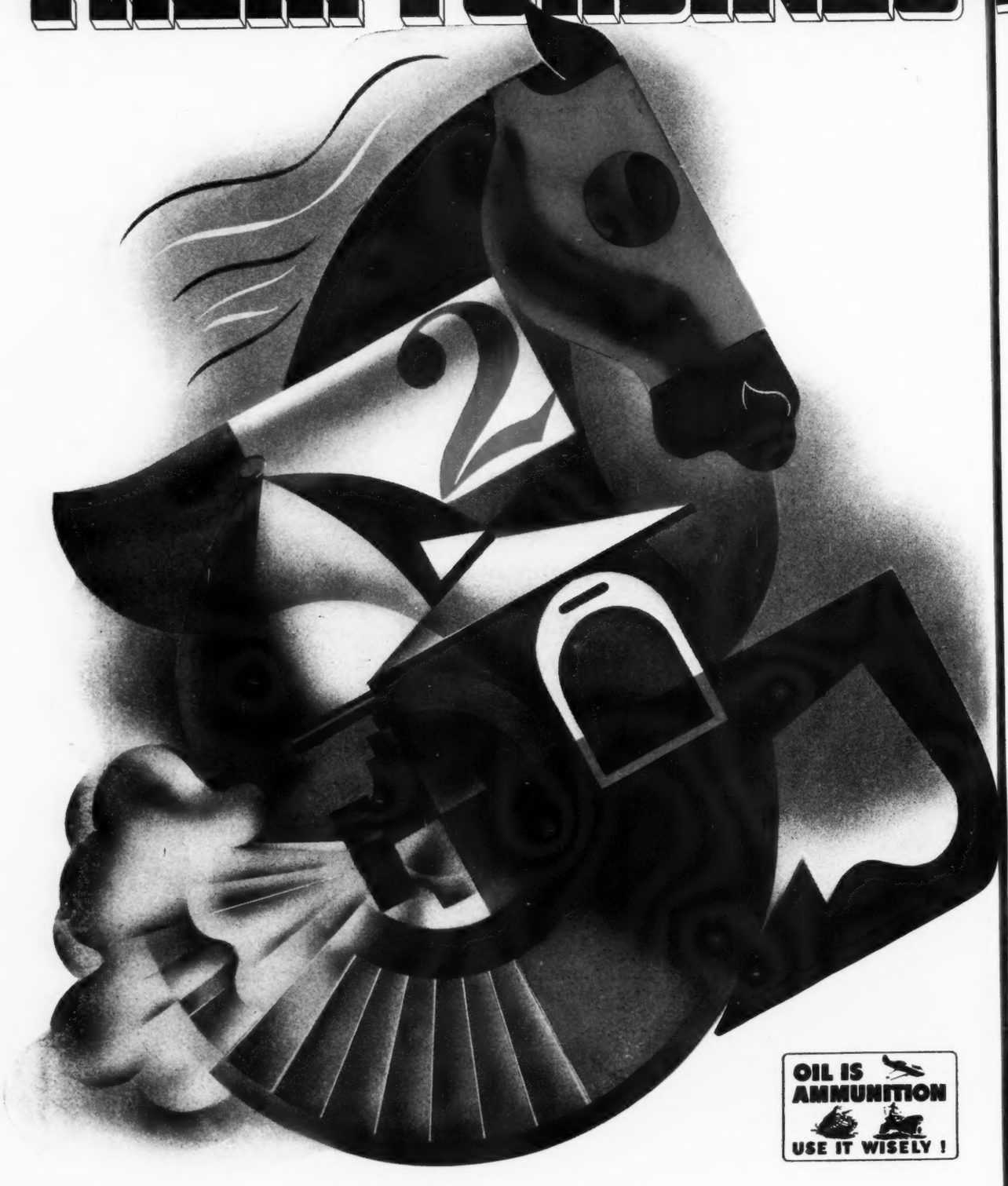
★ ***THEY SAVE REPLACEMENT.*** Sloan Valve durability may be verified in your own locality. Installations which are 15, 20 and 25 years old are common to every section of the country and every type of building.

THAT'S WHY—in office buildings, schools, hospitals, hotels, institutions, factories, apartments or public buildings, the vast majority of flush valves are Sloan. Now, as in peace time, there are more Sloan Flush Valves sold than all other makes combined.

SLOAN VALVE COMPANY • CHICAGO
4300 West Lake Street

SLOAN *Flush* VALVES

THEIR TURBINES



OIL IS AMMUNITION
USE IT WISELY !

RUN LIKE "2 year olds"

SINCE SWITCHING TO TYCOL TURBINE OIL

Seven turbines — averaging about 13 years of service, although they still run like two year olds — are supplying power for about a half million people. One important reason why age is no handicap here is because Tycol Turbine Oil keeps turbines in the prime of life for long years, yet lasts almost indefinitely itself. The oil in these same turbines has already been in use for more than 32,000 hours and is still in excellent condition.

Possibly you are dissatisfied with some phase of your plant lubrication. If so call in a Tide Water engineer to survey your operations. He will recommend from Tide Water's complete line of industrial lubricants the one designed to do your job best. For full details write to the Tide Water Associated Oil Company, 17 Battery Place, New York, N. Y.

DRUMS! DRUMS! DRUMS! DRUMS! DRUMS!

War needs make it extremely important that all empty drums be returned immediately.

Regional Offices: Boston, Philadelphia, Pittsburgh, Charlotte, N. C.

TIDE WATER ASSOCIATED OIL COMPANY EASTERN DIVISION 17 Battery Place, New York, N. Y.

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MAKERS OF THE FAMOUS VEEDOL MOTOR OIL

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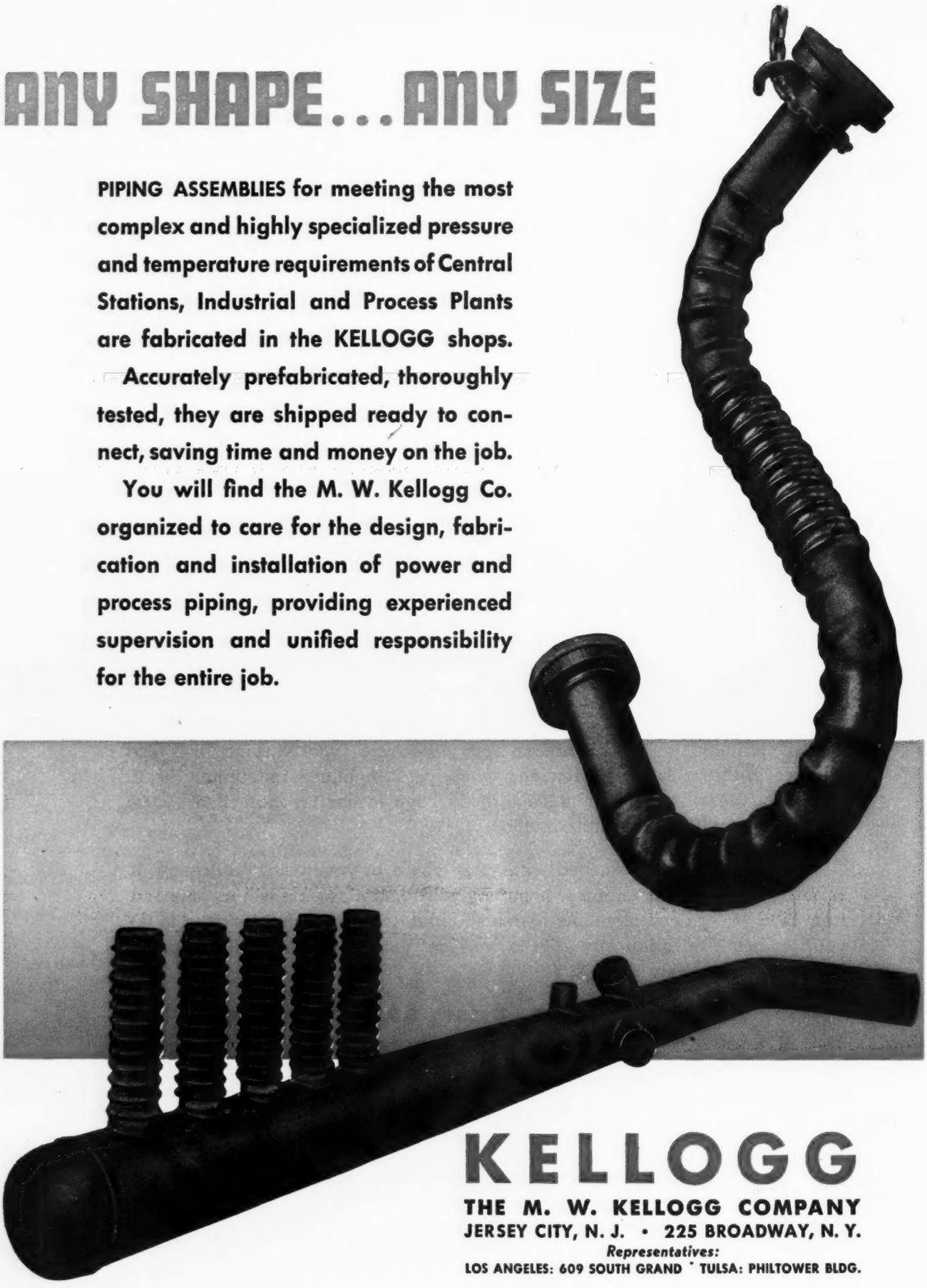
PIPING ASSEMBLIES for meeting the most complex and highly specialized pressure and temperature requirements of Central Stations, Industrial and Process Plants are fabricated in the KELLOGG shops.

Accurately prefabricated, thoroughly tested, they are shipped ready to connect, saving time and money on the job.

You will find the M. W. Kellogg Co. organized to care for the design, fabrication and installation of power and process piping, providing experienced supervision and unified responsibility for the entire job.



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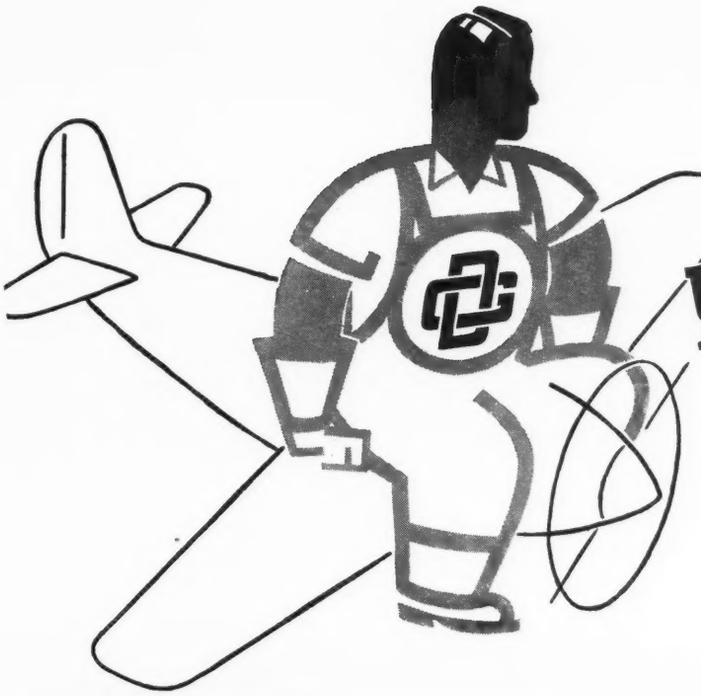
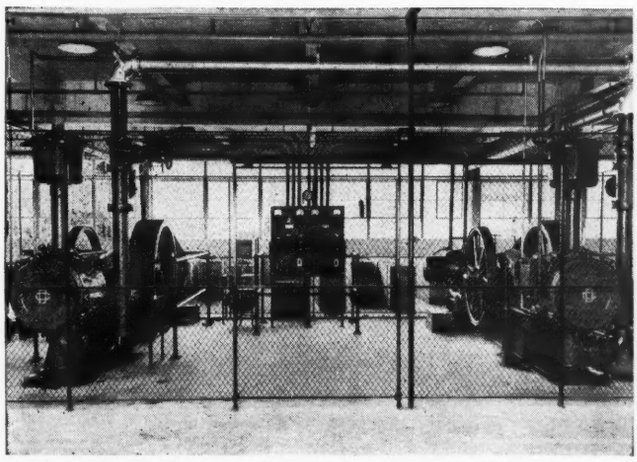
"Masterflex" Prefabricated Piping Systems • "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Reforming, Dehydrogenation, Alkylation, Desulphurization, Thermal and Catalytic Polymerization Units JUIK Processes for Lubricating Oil Plants. Plastic Refractories • Radial Brick Chimneys.



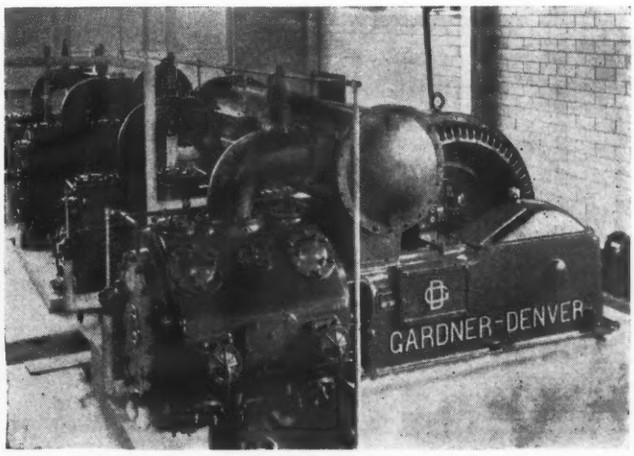
UP YOUR AIR TO UP PRODUCTION

There's a bigger job for compressed air in your plant today and tomorrow. Are you using compressed air power to the full? Do your present compressors have the capacity—the efficiency that modern production demands? Here are two Gardner-Denver Compressors that can step up your air capacity at a lower cost per cubic foot of air delivered.



1— DESIGNED FOR UNUSUALLY LOW HORSEPOWER REQUIREMENTS — GARDNER-DENVER "RX" SINGLE-STAGE HORIZONTAL AIR COMPRESSORS

- Long years of service assured by rugged, dirt-free construction.
- Extra efficiency due to liberal and unrestricted valve and port areas.
- "Air-Cushioned" Duo-Plate valves actually become tighter with use.
- Built in capacities from 89 to 1292 cubic feet displacement per minute.



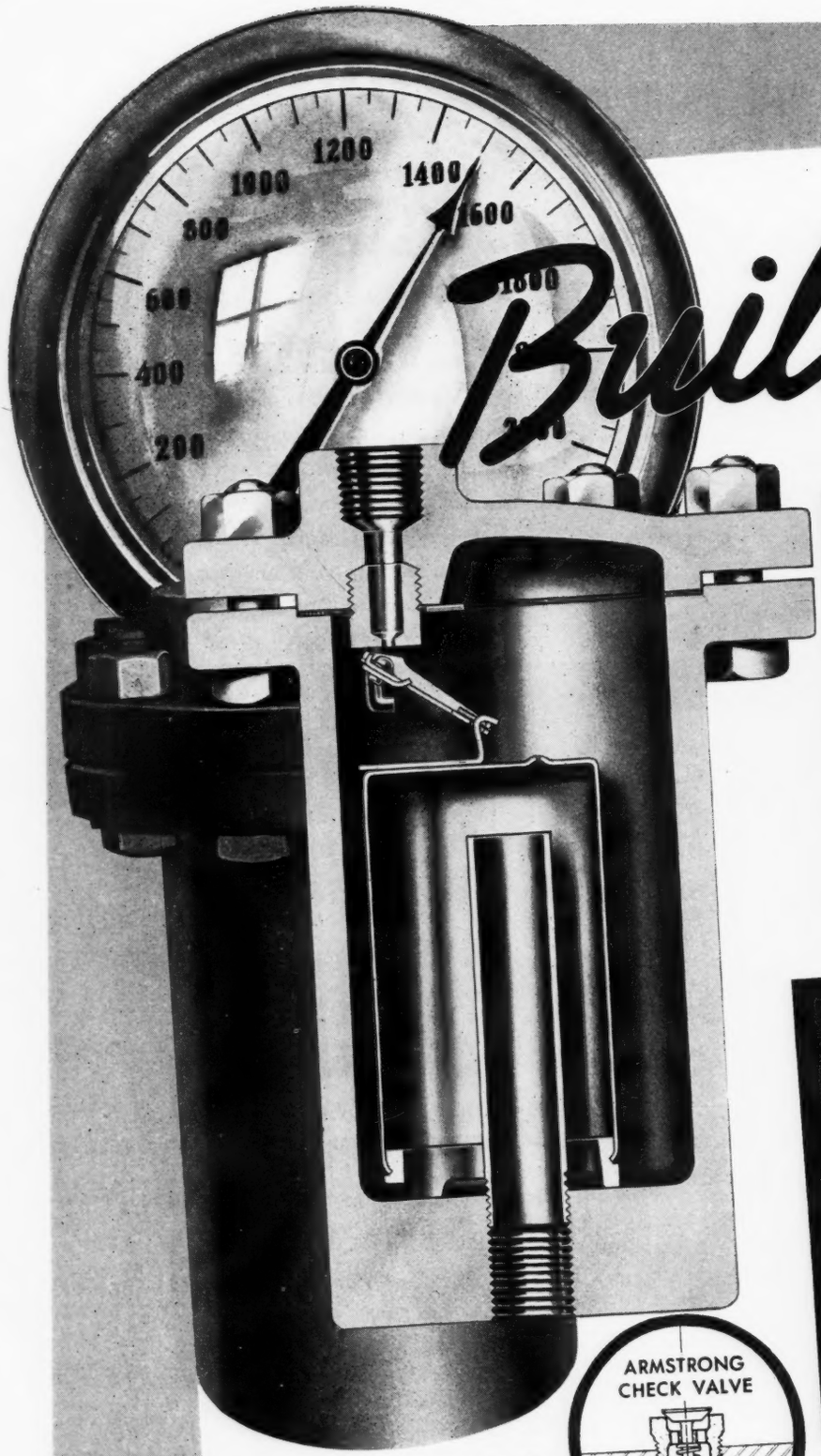
2— ENGINEERED FOR CONTINUOUS HEAVY-DUTY PERFORMANCE — THE GARDNER-DENVER "HA" TWO-STAGE HORIZONTAL AIR COMPRESSOR

- High overall efficiency assured by unrestricted air passages and large valve areas.
- A cooler running compressor assured by extra large water jacket areas.
- "Air-Cushioned" Duo-Plate valves decrease noise and wear—virtually eliminate valve breakage.
- Capacities range from 468 to 1854 cubic feet displacement per minute.

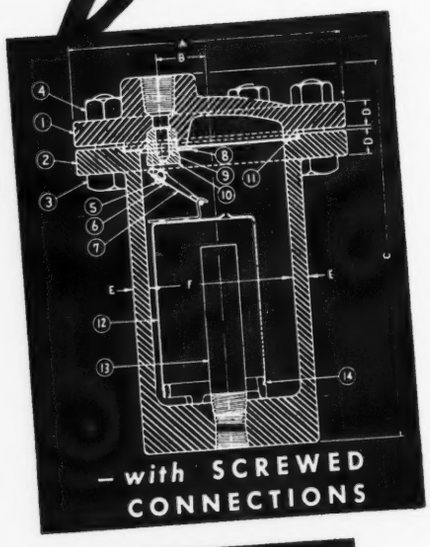
Write for complete information on the extra performance of Gardner-Denver "HA" and "RX" Horizontal Air Compressors. Gardner-Denver Company, Quincy, Illinois.

GARDNER-DENVER PRODUCTS KEEP SPEED V ICTORY

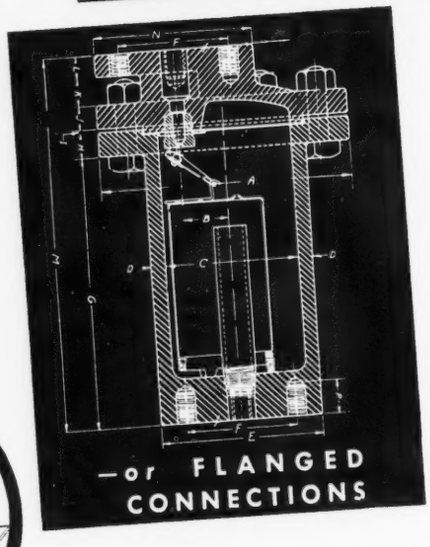
GARDNER-DENVER *Since 1859*



Built for



—with SCREWED CONNECTIONS



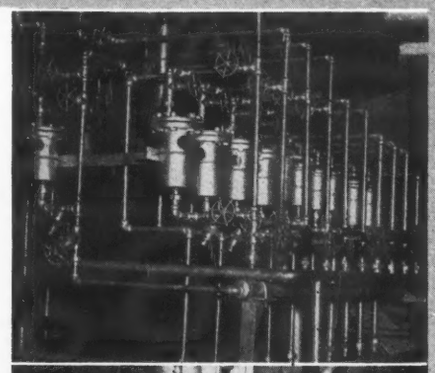
—or FLANGED CONNECTIONS

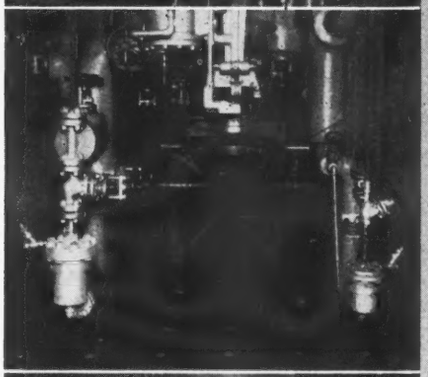
• Where check valves are required, specify ARMSTRONG INTERNAL TYPE CHECK VALVES — no external joints, quality construction, low cost!

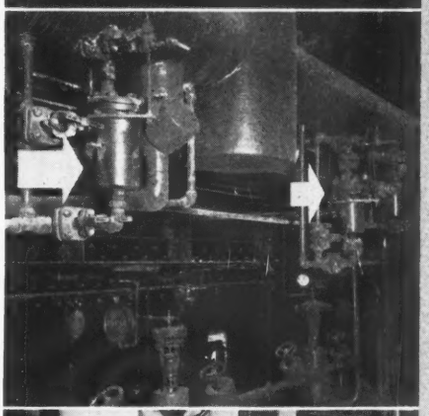
ARMSTRONG INVERTED BUCKET STEAM TRAP

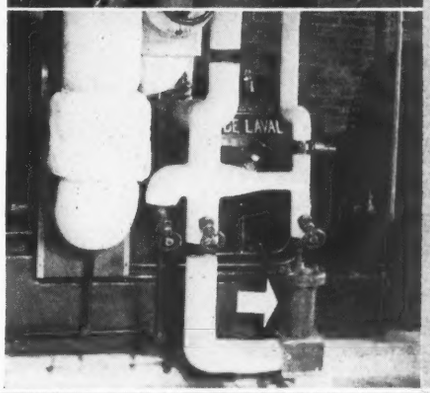
ARMSTRONG *Forged Steel*

HIGH TEMPERATURE HIGH PRESSURE SERVICE









ARMSTRONG pioneered the use of *special die forgings* for cap and body of high pressure steam traps, and Armstrong design has kept apace with the increased steam pressures used in modern central stations and industrial power plants.

ECONOMICAL TO USE! Wide choice of sizes starting with small ½ inch size. Built for either screwed or flanged connections.

FOR ANY PRESSURE! Built for 400, 600, 900, 1500 and 2400 lbs. steam pressure.

FOR ANY CAPACITY! Forged steel construction available for both plain traps and super-capacity compound traps.

UNSURPASSED QUALITY! Cap and body 79,000 lb. tensile strength, or higher. All-stainless steel trim. Heat treated valves.

COMPLETE ENGINEERING DATA. Printed information will be sent to you on request and without obligation. Complete capacity curves . . . trap specification and dimension sheets . . . installation diagrams.

ARMSTRONG MACHINE WORKS

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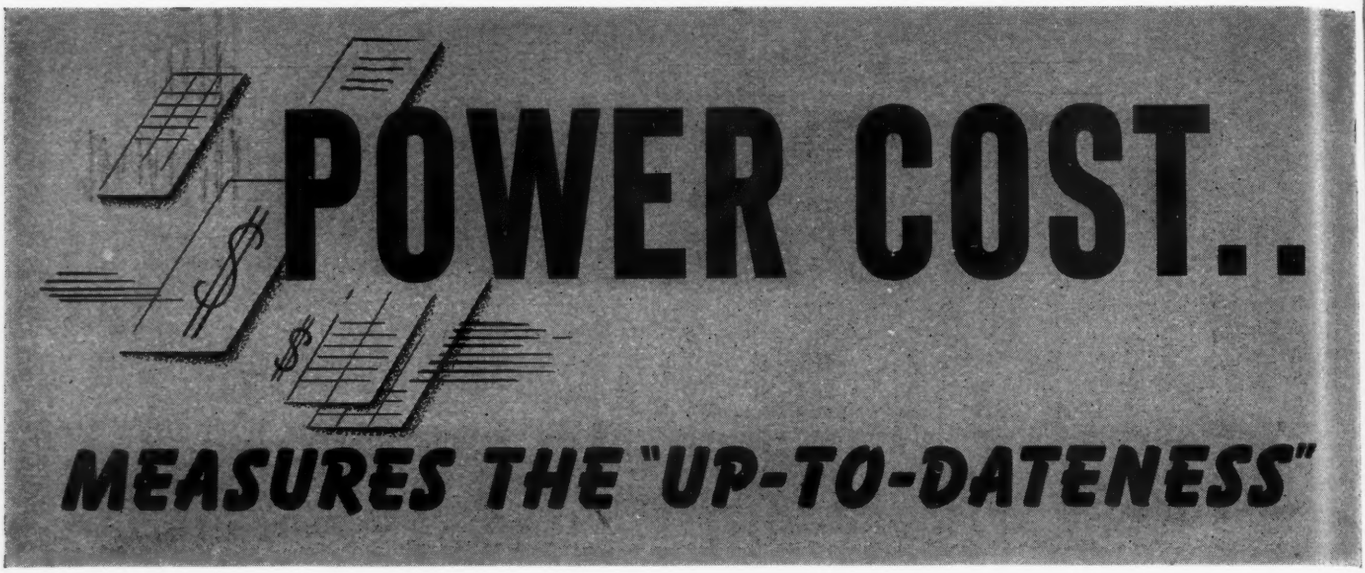
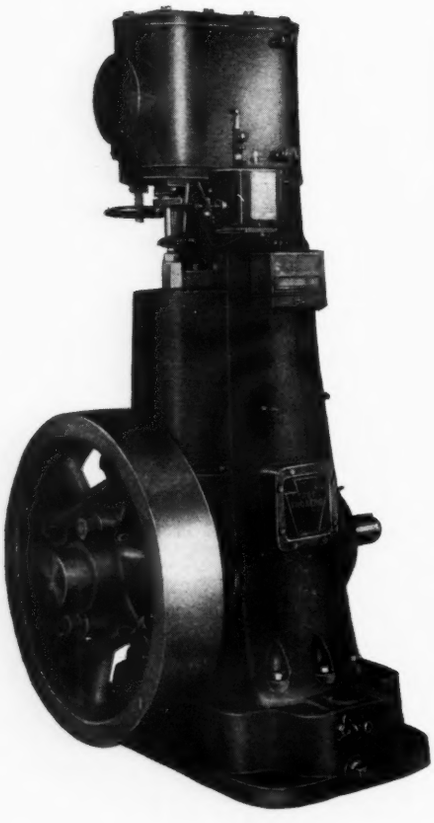
STEAM TRAPS

Saving Fuel, Metals and Manpower for the Battle of Production





TROY-ENGBERG
STEAM ENGINES

are widely used for driving
such equipment as

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COMPRESSORS
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AGITATORS
PUMPS
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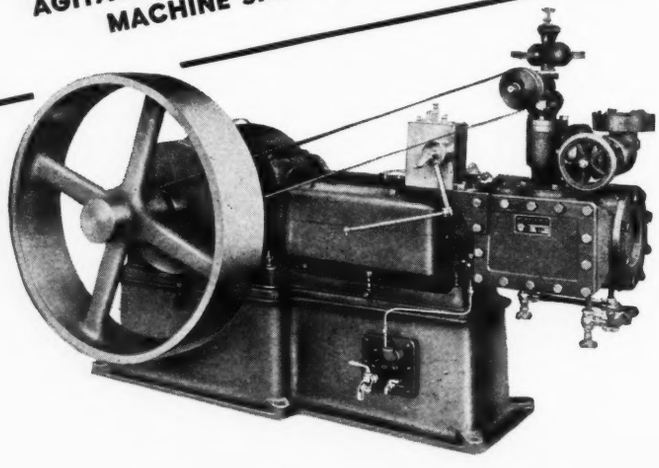
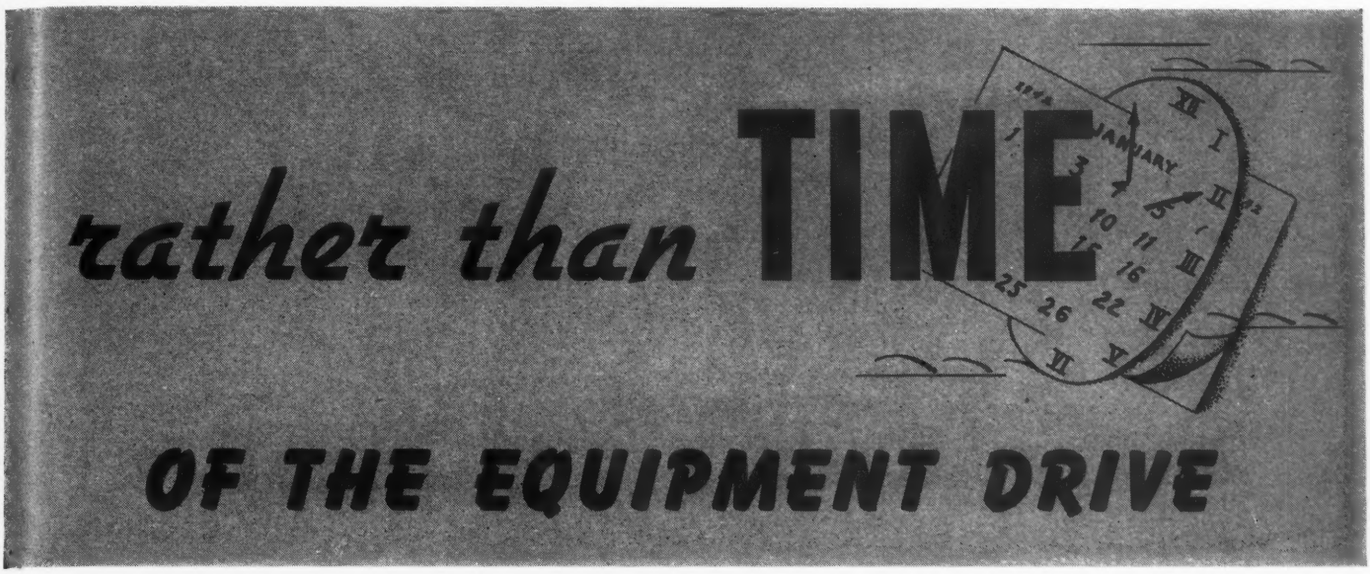


TROY-



Today's TROY-ENGBERG Steam Engine

. . . is as modern as today's calendar

DURING the past few years we have made some very careful detailed studies of over-all power costs — steam engine vs. other drives — right in plants using both and where competitive conditions prevailed. In many cases, the Troy-Engberg Steam Engines showed so much lower total power costs that there wasn't even a comparison.

Hundreds of Troy-Engberg Steam Engines are operating at around ½ cent per kw.h. for *all* costs; some higher, some lower. They are driving all sorts of equipment both in the power plant proper and out in the factory hooked up to production equipment. Such low power cost certainly stamps the drive as being modern.

Where conditions are right—and they are right in many plants—today's steam engine delivers dependable power at a lower cost than any other drive.

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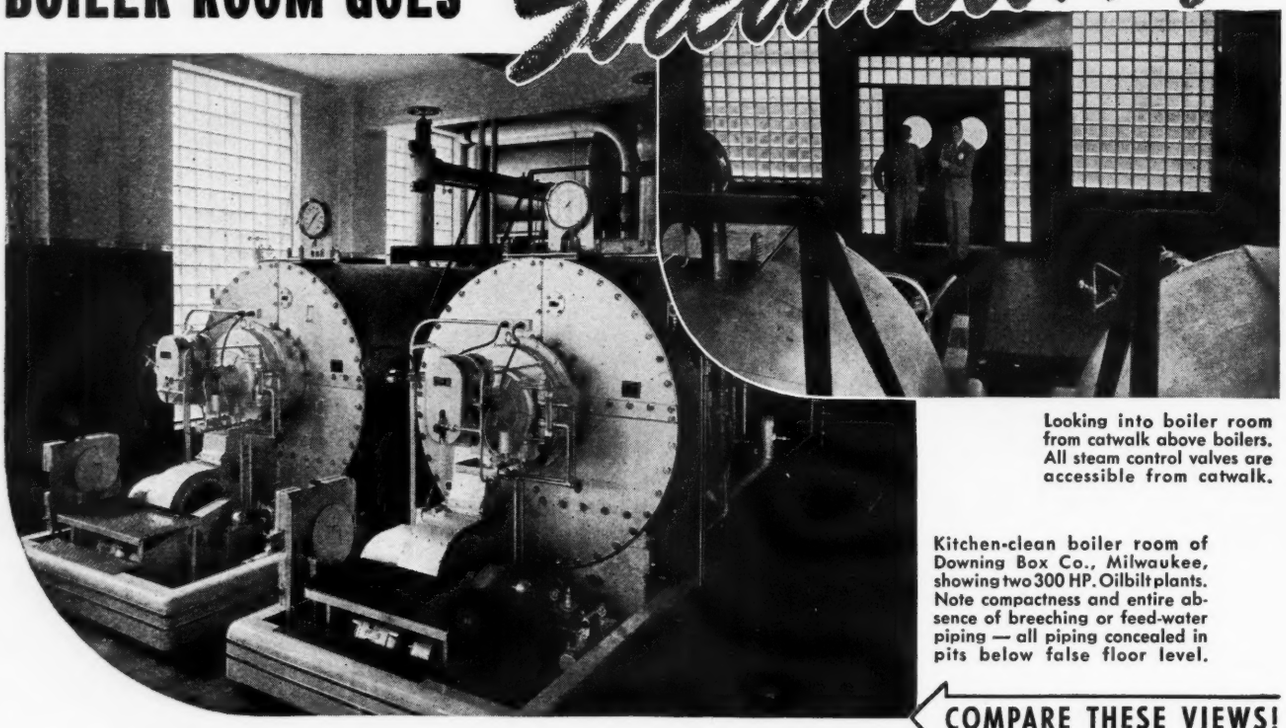
ENGBERG STEAM ENGINES • • • GENERATING SETS

BOILER ROOM GOES *Streamline!*



Looking into boiler room from catwalk above boilers. All steam control valves are accessible from catwalk.

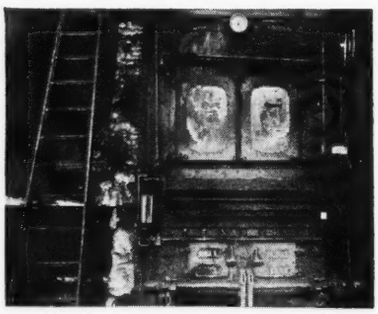
Kitchen-clean boiler room of Downing Box Co., Milwaukee, showing two 300 HP. Oilbilt plants. Note compactness and entire absence of breeching or feed-water piping — all piping concealed in pits below false floor level.

. . . OILBILT INSTALLATION MODERNIZES STEAM PLANT

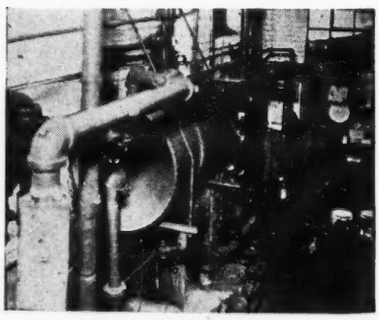
Here is a remarkable example of boiler room "face lifting." Two badly deteriorated, "coal eater" HRT boilers cramped into a 22 x 38 ft. space and congested with pumps, piping, stokers and coal piles — top output only 450 HP. at a limit of 125 lbs. pressure—replaced by two modern, clean, compact, efficient, oil-fired, 300 HP. OILBILTS with completely concealed piping and breeching connection, with room to spare in the same space.

OILBILT'S low head room requirement made possible the elevation of the operating floor level by a sub-structure meeting the factory floor lever thus concealing blow-down and feed-water piping. Downing Box Company, Milwaukee, well-known paper board and box manufacturers, now have a steam generating plant in keeping with their modern manufacturing plant.

COMPARE THESE VIEWS!



Dismantling of old boilers revealed previously undetected deterioration.



Showing old boiler feed-water pumping and supply system, manually controlled. Compare this congestion with clean, compact Oilbilt installation.

☆

Our "Victory" effort comes first. Greatly enlarged Cleaver-Brooks manufacturing facilities are going "around the clock" for military production.

☆

The Trend is to OILBILTS—The Modern Boiler Units

Specifically designed for efficient oil firing with a four-pass, down-draft construction with integral burner, OILBILTS are increasingly being installed for their many exclusive advantages:

- — high thermal efficiency — 80% guaranteed from 30% of rating to full rated capacity.
- — compact "packaged" construction saves space.
- — clean — no smoke, no ashes, no clinkers.
- — four-pass, down-draft construction gets all possible heat from fuel.
- — positive blower air supply eliminates high, costly stack.
- — performance tested, fully assembled, by manufacturer.
- — built by one company — one responsibility.
- — certified steam costs — complete performance tests may be obtained before shipment.

Built in sizes 20 to 500 HP., pressures 15 to 200 lbs.

Write for bulletin and complete information.

CLEAVER-BROOKS COMPANY, 5109 N. 33rd St., Milwaukee, Wisconsin

Oilbilt STEAM PLANTS

PERFORMANCE RECORD
COSTS CUT 29% BY CITIES SERVICE DIESEL OIL
The following data taken from actual records of a Milling Company show the manner in which a CITIES SERVICE DIESEL ENGINE OIL has out-performed competitive lubricants.
On February 1, 1938 CITIES SERVICE DIESEL ENGINE OIL was used for the first time by this concern as a crankcase and cylinder lubricant on a 300 h.p. Fairbanks-Morse Diesel Engine, replacing a competitive product which had been in use since March 1, 1932.
COMPARATIVE RESULTS
1. Barrels of Flour produced per gallon of oil used:
Competitive Oil..... 75
Cities Service Oil..... 88
Improvement..... 17%
2. Oil cost per M Barrels of flour produced:
Competitive Oil..... $7.80
Cities Service Oil..... $5.54
Saving..... 29%
3. Rated h.p. hours obtained per gallon of oil used:
Competitive Oil..... 1,167
Cities Service Oil..... 1,206
Improvement..... 3%
4. Oil cost per M rated h.p. hours:
Competitive Oil..... 50.65¢
Cities Service Oil..... 40.27¢
Saving..... 20%

(Name of above company furnished on request)

This report of a prominent flour mill shows clearly how Cities Service Diesel Engine Oil has out-performed competitive brands. We have similar records of performance of all types of diesel equipment. If you're generating power with Diesels, you should consult a Cities Service lubrication engineer. His experience and advice may save you time and money. Write today to any of the offices listed below. There is no obligation.

OIL IS AMMUNITION — USE IT WISELY!

A LUBRICANT FOR EVERY INDUSTRIAL NEED

A complete line of Service-Proved lubricants for all kinds of industrial applications, including—

Automotive	Mining
Canning	Paper
Cement	Power Generating
Food	Steel
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Machine	Etc.

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Our booklet "Diesel Engine Lubrication" will be sent free to personnel of Diesel lubrication oil users. P.R.

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Firm Name.....

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A LUBRICANT FOR EVERY INDUSTRIAL NEED

Don't let this war catch you with your

BOILERS DOWN

WE'RE in the army now! Our job is production—and more production. And maximum production requires a continuous supply of power without the delay and inconvenience of frequent time out for boiler cleaning or repair.

In hundreds of industrial plants throughout the country, Graver Water Conditioning Equipment is eliminating these unnecessary delays and helping to "keep 'em rolling, flying, and sailing."

Graver has designed, built, and erected water conditioning equipment for more than thirty years. This experience is available to you whenever needed and Graver engineers are ready to discuss any specific water treating problems and to submit unbiased recommendations. And you assume no obligation when requesting this help.

If you haven't received your copies of the following bulletins, write for them today. We will see that they are sent immediately.

Bulletin 301. Pictures and describes Graver Pressure Filters. Explains general construction and contains specification tables for both horizontal and vertical types.

Bulletin 303. Fully describes the Graver Hot Process Water Softener. Also contains detail drawings of two types of equipment plus other interesting information.

Bulletin 307. Covers Graver Zeolite Water Softeners as well as the six types of Graver Zeolites. Contains a series of six interesting flow diagrams covering waters of various characteristics.

WATER SOFTENERS
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FILTRATION SYSTEMS
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DAY

NIGHT

Light-proof ROOF VENTILATOR READY FOR BLACKOUT

1 Low height—streamlined appearance.

2 Guaranteed performance independent of wind and gravity.

3 Hinged top gives easy access to motor fan and shutter.

1 No light shows through. Ready for blackout without special treatment.

2 Non-overloading power characteristic assures trouble-free operation.

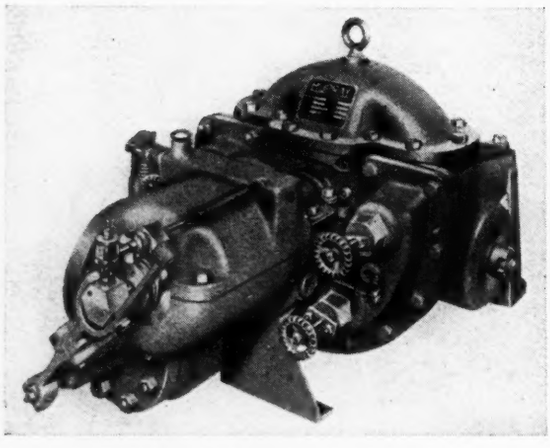
3 Harmonizes with modern plant design.

DeBothezat

FREE Detailed information on Light-proof Roof Ventilators. *WRITE TODAY.*

VENTILATING EQUIPMENT DIVISION ★ American Machine and Metals, Inc., East Moline, Illinois

MURRAY TURBINES

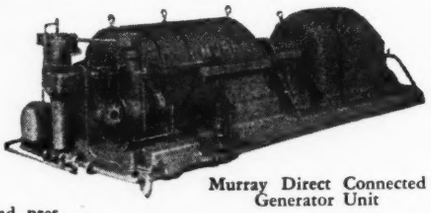


Murray Mechanical Drive Turbine

Murray Turbine-Generator units are built in sizes up to 3000 kw. Modern in design, highly economical, entirely automatic in operation with self-contained oiling system and forced lubrication to all bearings. Made in condensing and non-condensing types.

Murray Type "U" Single Stage Turbines are built in sizes from 25 HP to 1000 HP and operate at speeds from 1,000 to 5,000 R.P.M.

Murray also builds small non-condensing turbines for auxiliary service such as boiler feed circulating pumps, fans, etc. Send for complete information.



Murray Direct Connected Generator Unit

ALSO

Boilers of all types, sizes and pressures for large, medium and small power plants; High Speed Reduction Gears; Corliss Engines; Una Flow Engines; Unit Heaters. Write for details.

MURRAY IRON WORKS COMPANY

BURLINGTON **IOWA**

Goal Ahead

Like every thinking American, we are all out for Victory—Victory at the earliest possible moment.

Most of the 41 years of Youngstown's history have been years of peace. Like you, we look forward confidently to that day when steel can turn from its terrible work of destruction to the constructive task of restoring the foundations and rebuilding the structure of our national health and prosperity and happiness.

Victory when it comes must be unqualified, and complete. Victory calls for hard work—unstinted, total effort. So let us devote every machine and every ounce of manpower to the winning of the war. That is American Industry's task for TODAY——not tomorrow, but NOW.

THE YOUNGSTOWN SHEET AND TUBE COMPANY

YOUNGSTOWN, OHIO

25-31E

How SMOOTH-ON helps to prevent production delays

This 5-ft. dia. inclined ball mill cracked between the ribs. By using Smooth-On No. 1 to make the repair, no heat was required, which eliminated the danger of causing new cracks or of spreading the old crack. The Smooth-On No. 1 was applied under a patch plate which reinforces and strengthens the casting. The application is simple and the repair can be made in place.

A leak in a pipe line . . . a crack in a pump casing . . . a loosened bracket due to stripped threads . . . these are typical of plant operating troubles which might cause loss of valuable production time if not properly corrected.

You can make repairs like these . . . without dismantling apparatus, without heat or special tools, and with lasting results . . . by using SMOOTH-ON No. 1, the iron repair cement of a thousand uses.

Whenever a crack develops in a casting, or a leak occurs in a seam or joint, or a machine part or fixture becomes loose . . . SMOOTH-ON will correct the trouble speedily and economically, frequently avoiding costly interruptions to service.

Buy Smooth-On in 7-oz., 1-lb., 3-lb. cans or larger kegs. For your protection, insist on Smooth-On, used by engineers and maintenance men more than 35 years. Obtainable from your supply house, or if necessary, from us.

SMOOTH-ON CEMENTS

for the Motor Car and Boat, Home, Factory and Power Plant

FREE *40-Page Handbook shows how*

This handy repair manual is an essential part of the library or kit of every engineer and maintenance man. Illustrated by 170 diagrams showing short cuts on repair jobs all over the plant. Send the coupon today for your free copy.

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Do it with **SMOOTH-ON**

FORGET ABOUT *Pressure* BUY ON *Endurance!*

This is no time to split hairs when buying fittings. Now is the time to buy high-temperature high-pressure fittings even for moderate service conditions—because they last longer, through future months and years when fittings may be a lot harder to get. Tests prove that, in nearly all cases, the added endurance of higher-rated fittings more than outweighs their additional first cost.

W-S Forged Steel Fittings in both welding and screw end types are available from distributors' stocks in a wide range of sizes and pressure ratings.

Now—if never before and never again—buy W-S High-Pressure High-Temperature Fittings for your uses. All facts are in Bulletin A-3. Get it now. Then consult your Mill Supply Distributor. Look for The Double-Diamond Trademark.

THE WATSON-STILLMAN CO.

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Engineers and Manufacturers of Forged Steel Fittings and Valves, Hydraulic Machinery and Equipment—Hydraulic Presses, Pumps and Jacks

2496

STEM OF SPECIAL CORROSION-RESISTING, HIGH STRENGTH ROLLED BRONZE

SUBSTANTIAL WALL THICKNESS OF PRATT & CADY BRONZE VALVES RESIST CORROSION AND EROSION

HEAVY HEX PROVIDES GREAT RIGIDITY

FIRST, REGRIND AS MANY TIMES AS POSSIBLE
THEN REPLACE ONLY THE SEAT AND DISC

...—*Save* ALL THAT BRONZE

READING-PRATT & CADY MADE IT POSSIBLE FOR YOU TO *RENEW* BRONZE VALVES INSTEAD OF REPLACING THEM

It is imperative, when it comes to Bronze and other metals now scarce and strategically important, that we all return to old-time thrift—*use it, mend it, make it do.*

Remember this when your Bronze valves show signs of the wear and tear of 24-hour Victory production because in very few cases do you need to *replace* them.

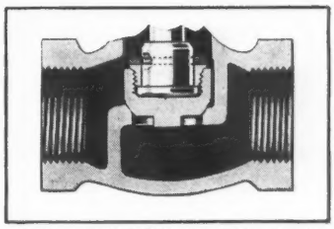
1885—PRATT & CADY INVENT GLOBE VALVE WITH RENEWABLE SEAT AND DISC

By inventing the Globe Valve with renewable seat and disc, Pratt & Cady made it possible for you to *renew* your worn Globe Valves—to use minimum materials and time for the maintenance job.

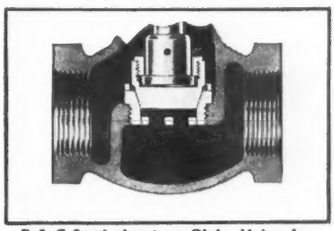
By inventing and patenting the Retaining Ring Gate Valve—diagram at the bottom to the right—Pratt & Cady made it practical to renew the seat of Gate Valves without removing the valve from the line.

So, again, we say save all that *Bronze*. First, regrind disc and seat to an efficient seat as many times as the materials can be worked-over. Then replace only the disc and seat—in that way maintaining your valves at peak efficiency with minimum use of vital materials and precious time. *RENEW* your valves. DON'T REPLACE them.

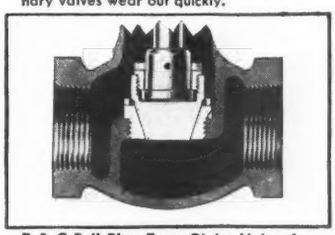
Reading Cast Steel Valves & Fittings • Pratt & Cady Brass & Iron Valves
D'Este Valve and Engineering Specialties



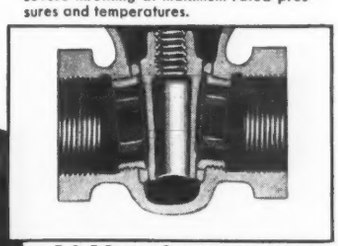
P & C regrinding Globe Valve. Occasional throttling of air, hot water, saturated steam.



P & C Semi-plug type Globe Valve for frequent throttling in services where ordinary valves wear out quickly.



P & C Full Plug Type Globe Valve for severe throttling at maximum rated pressures and temperatures.

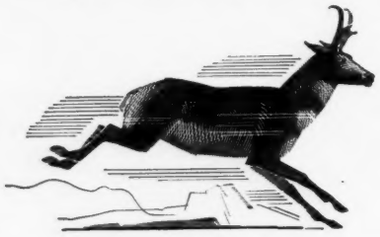


P & C Bronze Gate Valve, retaining ring construction. Perfect seating without machining with seat rings in place.

READING-PRATT & CADY
READING, PENNSYLVANIA

A Division of AMERICAN CHAIN & CABLE COMPANY, INC. Bridgeport, Conn.

A tortoise travels about
2/5 miles per hour



A pronghorn antelope runs
60 miles per hour

The deer botfly can travel
more than 450 miles an hour

The earth speeds along its orbit
at 65,600 miles per hour

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The World's Fastest Complete Boiler Tube Service

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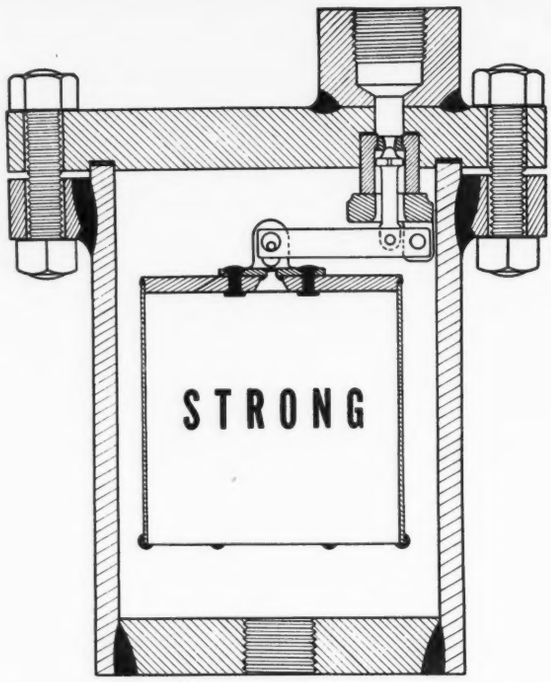
PIPEWRENCH PETE SAYS:

New **WELDED Steel Trap for high pressures**

Certified Fabrication...Proved Design



Use WELDED *top quality* TRAPS for pressures to 600 lbs. (Temp. 750° F.)

You'll find these sturdy steel traps of proved design just right for high pressure, high temperature lines. STRONG certified operators and fabrication methods save manufacturing time and offer you striking economy without sacrificing rigid Strong quality.

WELDED (Series 90) TRAPS are constructed from seamless steel tubing—steel cover fastened with alloy steel bolts.

Such standard Strong features as—anti-balancing device, ANUM-METL valve-seat-pins, stainless steel bucket and lever. Internal bolted seat easily removed after years of service. *Write for information or call your Strong distributor.*

The Strong, Carlisle & Hammond Co.
1392 W. Third Street, Cleveland, Ohio

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WAR—Strong Specialties are now needed for war plants (explosives, chemicals, aircraft, ships, etc.) PLEASE CONSERVE present Strong equipment. Use repair parts to restore efficiency . . . increase production . . . save steam (fuel) . . . save money.

14

STRONG
STEAM SPECIALTIES

What the well-dressed welding fitting wears—

You see at a glance
the size and thickness of a
WeldELL

NO guessing . . . no measuring . . . no "miking." No wrong size mistakes among fittings delivered to the job . . . no trips back to the stock room to correct errors. Not if you use WeldELLS, for every one is fully and permanently marked and you see at a glance the size and thickness you're getting.

This is just one of the "convenience features" of WeldELLS that help keep welded piping costs down to an absolute minimum.

But that isn't all, for WeldELLS have other advantages, too. Some save installation time . . . others provide engineering improvements. Combined they give you the extra value that makes WeldELLS the "best buy."

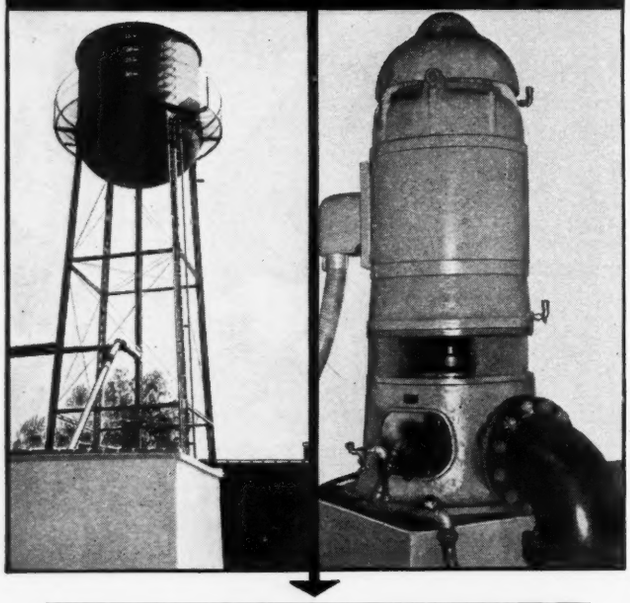
TAYLOR FORGE & PIPE WORKS
General Offices & Works: Chicago, P. O. Box 485
New York Office: 50 Church Street
Philadelphia Office: Broad Street Station Building

WeldELLS have *everything*

No other fittings for pipe welding combine these eight features. Besides permanent markings (described here) the features are:

1. **Seamless**—greater strength and uniformity.
2. **Tangents**—keep weld away from zone of highest stress—simplify lining up.
3. **Precision quarter-marked end**—simplify layout and help insure accuracy.
4. **Selective reinforcement**—provides uniform strength.
5. **Wall Thickness never less than specification minimum**—assures full strength and long life.
6. **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
7. **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

JUST WHAT DO
DEMING TURBINES
OFFER YOU?



LOW COST WATER
continuously!

War schedules are fast going into an all-out, round-the-clock pace. Continuous, dependable, low cost water supply is vital. Under these conditions, just what do Deming Deep Well Turbines offer you?

1. Positive lubrication whenever pump is operating. Pump lubricates itself with water from well.
2. Cutless rubber bearings eliminate close-fitting, metal-to-metal bearings which are subject to damage by sand or grit.
3. Easy maintenance of stuffing box which is located in discharge head for quick accessibility.
4. Protection of water supply against contamination by oil or grease as pump is water lubricated.
5. Ease of installation due to simplified construction.

Bulletin 4700-8 is a 20-page illustrated technical description of all features and performance factors relating to Deming Deep Well Turbines. It's yours for the asking.

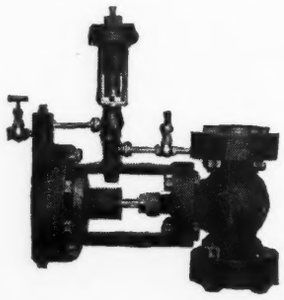
THE DEMING COMPANY • SALEM, OHIO

DEMING

DEPENDABLE PUMPS

Squires CLASS E PUMP GOVERNOR

Is simple in construction and fulfills all conditions required of a pump governor. Real service is expected from every cash outlay for mechanical equipment, and Squires Steam Specialties are a receipt in full for such investments. It's worth your while to inquire about them.

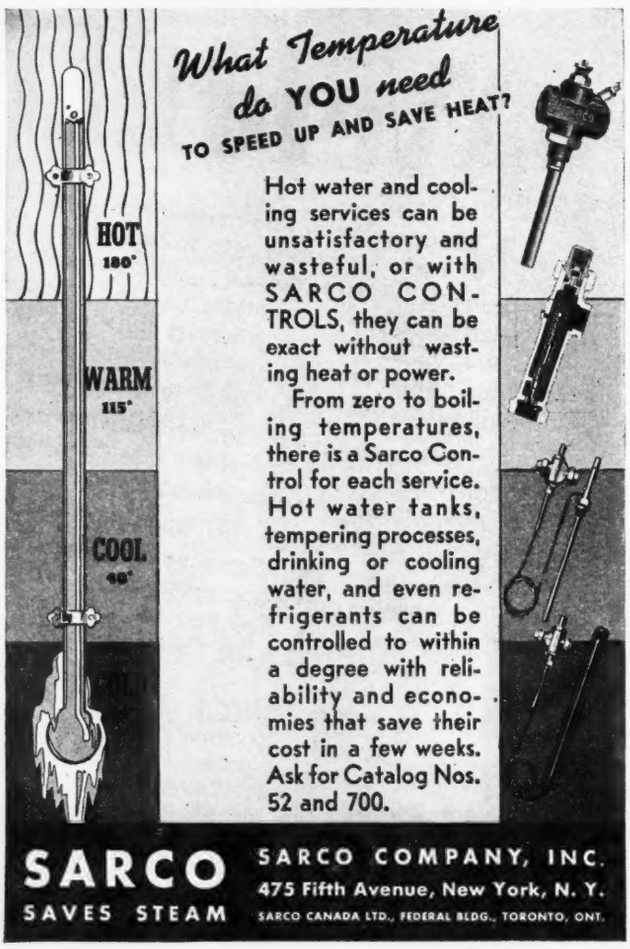


Squires Class E Pump Governor

Described in Catalogue A-11. Sent upon request

The C. E. Squires Company

East 40th St. and Kelley Ave., Cleveland, Ohio



What Temperature do YOU need TO SPEED UP AND SAVE HEAT?

Hot water and cooling services can be unsatisfactory and wasteful, or with SARCO CONTROLS, they can be exact without wasting heat or power.

From zero to boiling temperatures, there is a Sarco Control for each service. Hot water tanks, tempering processes, drinking or cooling water, and even refrigerants can be controlled to within a degree with reliability and economies that save their cost in a few weeks. Ask for Catalog Nos. 52 and 700.

SARCO SAVES STEAM

SARCO COMPANY, INC.
475 Fifth Avenue, New York, N. Y.
SARCO CANADA LTD., FEDERAL BLDG., TORONTO, ONT.

Keeping the wheels turning

Basic to all war production is the supplying of the energy needed to keep the wheels of our war production turning at ever-increasing speeds. In the power industry, as in other phases of America's war effort, Beth-Co-Weld Pipe is carrying a substantial share of the load.

Made by the modern continuous-weld process, Beth-Co-Weld is uniform in quality, characteristics, dimensions and strength. That means faster, easier installation, and greater dependability in any power plant.

Beth-Co-Weld is made in all sizes up to three inches, black and galvanized, standard weight and extra-strong, in uniform 21-foot lengths, plus or minus one inch.

UNIFORM BETH-CO-WELD PIPE

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

BTU's ARE BULLETS TODAY

DON'T LET INEFFICIENT INSULATION WASTE THEM

For all-out output, every B.T.U. must deliver its full quota of useful work today. Eliminate wasteful heat loss, jack-up production, reduce operating costs and conserve America's fuel and transportation by covering uninsulated or under-insulated surfaces with efficient Mineral Wool Insulation.

Check these advantages of Industrial Mineral Wool over other types of insulation:

1. **EFFICIENCY. Mineral Wool Insulation has low thermal conductivity. Its resilient fibers entrap a maximum of "dead-air" . . . nature's own best insulator.**
2. **EASY TO APPLY. Lightweight. Easy to handle. Doesn't pack-down. Each pound covers more surface more efficiently.**
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6. **CONVENIENT. Mineral Wool Insulation is available in bulk, in blankets, in blocks and as insulating-cement. Prominent producers have ample stocks in nearby distributors' stocks.**
7. **LOW COST. No other insulation does so much for so little.**

Conserve America's natural resources . . . cut operating costs . . . increase production . . .. investigate the many advantages of *efficient* Mineral Wool Insulation for piping, valves, fittings, boiler and furnace walls, heaters, ducts, tanks and processing equipment.

Write now for data on Industrial Mineral Wool Insulation

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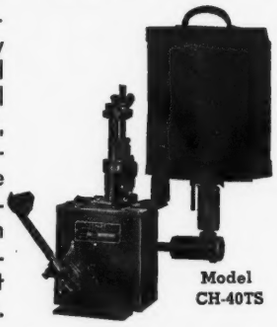

Model CH-40TS

No attention is required after feed is set except to maintain chemical supply in tank.

Treating chemicals go further and do a better job when injected by a Manzel Feeder. All feed water is treated with accurately measured amounts of chemical so top boiler efficiency is maintained longer.

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Reg. U. S. Pat. Off.

10 Advantages of this ONLY TRULY COMPLETE Underground Pipe Conduit

1. Less excavation required.
2. Installation work can be started immediately. Tile not required on job until after pipe has been installed and tested.
3. Pipe supported on solid concrete foundation. Permanent grade level. No condensate pockets.
4. Pipe installed on foundation with no interference of tile or other trades working in trench at same time.
5. Internal drain in concrete base allows no accumulation of water in conduit.
6. Internal drains connected through manholes and not outside of manholes. Permits periodical inspection.
7. Arch construction permits greater loads to be carried on top of conduit than with other shapes.
8. No bell joints, hence easily waterproofed with membrane waterproofing.
9. Repairs to steam line easily made at any time.
10. Greater thermal efficiency. Surrounded by air rather than by damp earth.

In addition Therm-O-Tile is durable; permits expansion and contraction; cave-ins and inclement weather cause less damage and expense. Etc. Ask for Bulletin 381.

Sold and installed by Johns-Manville Construction Units in all Principal Cities.

See our page in Sweet's or The Heating Guide.

H. W. PORTER & CO., Inc.
827-P Frelinghuysen Ave. Newark, New Jersey

CINDERTRAPS

IT'S "ALL-OUT" *even to cinders* - in these plants!

Partial List of Recent Installations

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Campbell Soup Company
Cincinnati Milling Machine Company
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New York Navy Yard
Castanea Paper Company
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City of Decatur, Ind.
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When you push stoker fired boilers at high ratings in an "all-out" for victory, there is no need of pushing cinders out of the stack and sprinkling men, machines, and materials with dirty particles. Take them "all out"* of the flue gases—with Green Cindertraps.

As these cindertraps are of the gravity baffle type and have no moving parts, there are no power costs. As the velocity of the gases passing through the baffles is relatively low — as no water is used in any part of the system, there is but little wear or corrosion—practically no maintenance.

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* Recoveries obtained *in service* have been as high as 90 per cent by weight of the total—draft loss, 0.1 to 0.2 inches.

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MECHANICAL DRAFT FANS · AIR PREHEATERS · ECONOMIZERS · CINDERTRAPS

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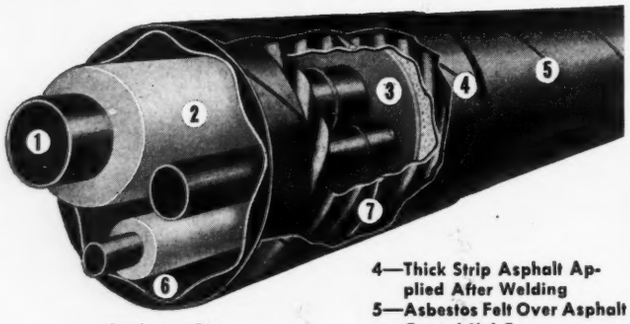
PRE-FABRICATED



1—Steam Pipe
2—Sectional Pipe Covering
3—Pipe Support
4—Thick Strip Asphalt Applied After Welding
5—Asbestos Felt Over Asphalt Coated Hel-Cor
6—Air Space
7—Butt Welded Construction

UNDERGROUND STEAM SYSTEMS DELIVERED COMPLETE . . . IN RECORD TIME!

Pre-fabrication by Ric-wiL means:

★ Cost reduction! . . . turning out mass-produced Insulated Underground Steam Pipes almost overnight—at minimum and definite predetermined cost to the contractor and user.

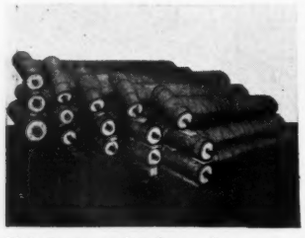
★ Time saving! A steam system "on the drawing boards" carries no steam. RIC-WIL "lays it on the line" NOW—when and where you need it!

★ Controlled factory assembly-line methods which have delivered over 800,000 lineal feet of Ric-wiL Units, in pipe sizes from 1″ to 16″ diameter, in the past 18 months, principally for government defense work.

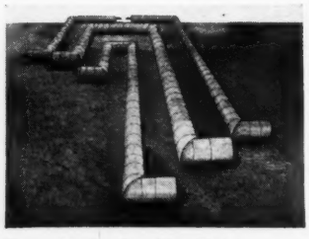
★ Units of basically correct design, including expansion fittings and all parts, which are standardized and machine-made with precision workmanship. Construction of Ric-wiL fits into the working practice of various trades in the field, radically cutting time and cost on the site. No bottlenecks—no confusion.

★ The result is a Pre-sealed System, in the form of a truckable Unit, completely finished in the shop, with nothing extra to buy, ready to install . . . and turn on the steam!

FOR ACTION—wire us for name of nearest Ric-wiL representative. Write for latest Ric-wiL Bulletins.



Hairpin expansion loops for flanged units



Expansion bends with offsets

RIC-WIL INSULATED PIPE UNITS
THE RIC-WIL CO., CLEVELAND, O.
Agents in Principal Cities

Are you equipped to hold your job?—to get a new one?

The men who are keeping their jobs today—who are not feeling the whip of competition—are those who have kept one jump ahead of their jobs. They are the men who are equipped with a thorough-going and growing knowledge of the business they are in.

It works in the power plant field as well as in any other. Some men fit themselves to do a little more than their job calls for. They fit themselves to do a little more than the other fellow. They make a steady effort to equip themselves with the best kind of job insurance there is—KNOWLEDGE.

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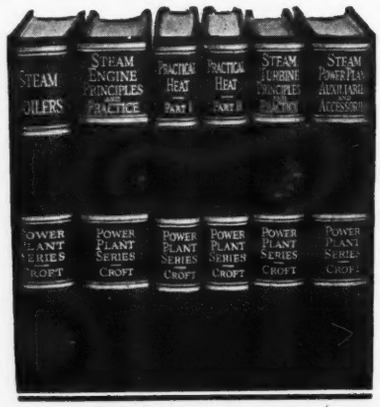

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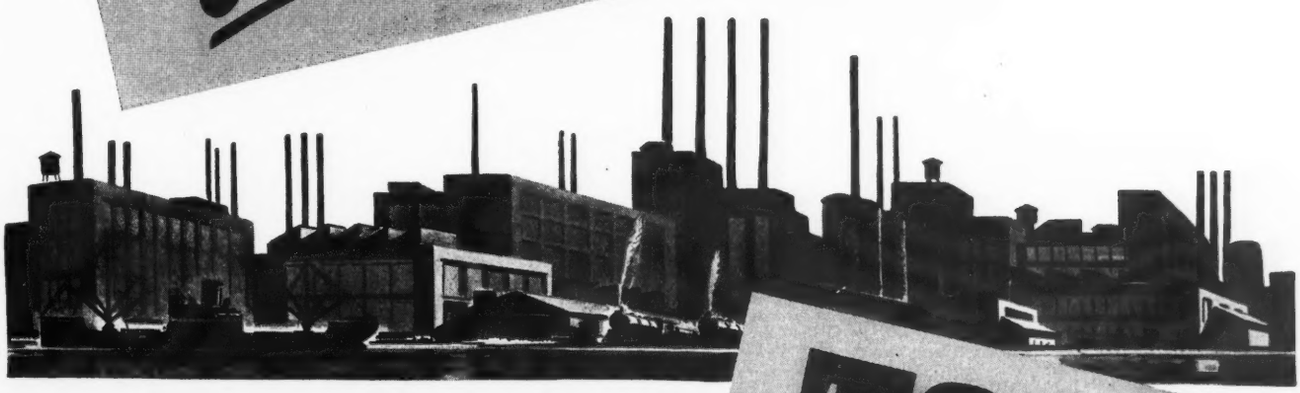
Position .....P. 4-42

UNFAILING POWER for UNINTERRUPTED PRODUCTION



TODD COMBUSTION UNITS

• Is your power plant geared to the all-out war effort . . . the demands of the new 168-hour week?

ALL-OUT, America! The task is huge . . . the time short! To produce the staggering quotas now called for, your power plant must operate *without interruption*—at *top capacity*—and with *maximum efficiency!*

In plants of every type throughout the country, Todd installations, specially engineered to meet individual problems in the firing of liquid and gaseous fuels, are hitting new highs in efficient power production—under gruelling conditions. Todd technical-service staffs assure smooth, trouble-free operating performance . . . are instantly available in any emergency with parts and replacements from complete stocks in convenient key cities.

Whatever the size of your plant, Todd engineers will gladly confer with you on your combustion problems.

TODD COMBUSTION EQUIPMENT, INC.

(Division of Todd Shipyards Corporation)

601 West 26th Street, New York City

TODD NEW YORK, U.S.A.

NEW YORK MOBILE NEW ORLEANS GALVESTON SEATTLE BUENOS AIRES LONDON

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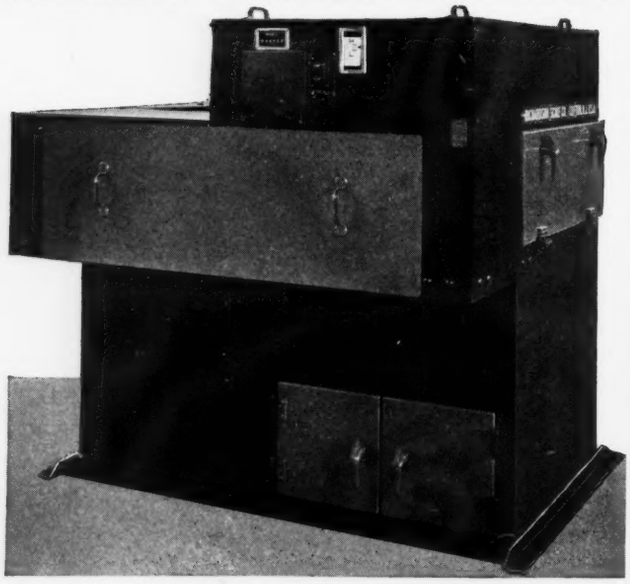
STOP POWER WASTES

A FIRST STEP TO VICTORY

Get greater power efficiency by putting your boilers under continuous automatic test—with—

RICHARDSON AUTOMATIC COAL SCALES



Only RICHARDSON AUTOMATIC COAL SCALES can tell you definitely and accurately the exact amount of coal fired; whether one boiler is burning more coal than another. You'll know which boiler is the slacker in its failure to keep up to the maximum pounds of water evaporated per pound of coal.

The operation of this scale is continuous, accurate and automatic, recording on a reliable mechanical counter, coal weight from overhead bunkers to stokers or pulverizers.

Many new features have been added to the new IMPROVED RICHARDSON AUTOMATIC COAL SCALE assuring greater efficiency and longer life. The new streamline sheathing protects the scale against dust and damage. Covered weighing mechanism is guarded against tampering. Larger inlet spout prevents clogging and increases feeding speed. As a further protection, all parts that come in contact with coal are stainless steel.

Bulletin S21240 gives complete technical data. We'll be glad to send you a copy.

GET "ON TEST" BOILER EFFICIENCY WITH A RICHARDSON.

RICHARDSON

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RICHARDSON SCALE COMPANY, CLIFTON, N. J.

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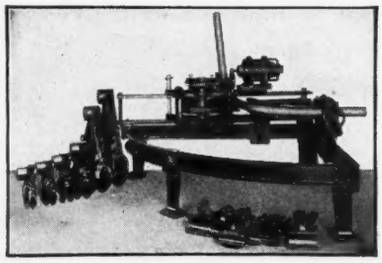

FOR NATIONAL DEFENSE

We Are Ready To Serve You

The American Cold Pipe, Conduit and Tube Bending Machines

QUICK DELIVERIES . . .

HAND OPERATED TYPES in capacities of 1 in., 2 in., 3 in., and 4 in.

MOTOR OPERATED in three capacities, ½ in. to 4 in., ½ in. to 6 in., and ½ in. to 8 in.

Immediate shipment on hand operated machines; on motor powered from two to four weeks. Wire or air mail letter for printed matter and prices.

Three New Machines: No. 1. For bending extra heavy pipe up to 3". No. 2. For bending all kinds of thin gauge tubing without use of mandrel. No. 3. For bending IPS conduit.

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ONLY **WEDGE Split CHILL RINGS ADJUST *themselves* TIGHTLY**

Split Feature Patented

1 → SAVE LABOR
2 → SAVE MATERIAL
3 → SAVE TIME

Because of the exclusive patented SPLIT Feature, WEDGE Chill Rings are FLEXIBLE, and that is why they adjust themselves TIGHTLY to the irregular diameter of unfinished inside surfaces of pipe. That is what makes WEDGE Chill Rings so much more efficient than ordinary rings. You can weld FASTER; also get a STRONGER joint because you get 100% penetration. Why don't you investigate?

Write for Circular and Prices

WEDGE PROTECTORS, INC.
9524 Richmond Ave. Cleveland, Ohio

WEDGE CHILL RINGS SAVE MONEY

introducing Tanalginate...

...a new reactive and protective organic colloid developed to supplement such simple chemicals as phosphates and alkalis in the correct conditioning of boiler feed water... a modern material for a modern method of feed water treatment that will...

(1) Eliminate baked sludge deposits because of the fluidity of the sludge.

(2) Permit increases in permissible boiler water concentrations without affecting the quality of steam.

(3) Minimize foaming and priming through the adsorption of crystalline precipitates.

(4) Decrease blow-down as much as fifty per cent.

(5) Reduce the cost per unit of water treated.

If you are pushing your boilers overtime in an "all-out" for production, now is the time to investigate "*Tanalginate*" before scale, corrosion and carry-over cripples your equipment and boosts your bills. Write to our nearest office for complete information—today.

Send for these handbooks of useful information

Here are three booklets that should interest every engineer concerned with feed water treatment and control. One covers types of water, situations and treatments; another gives complete information on "*Tanalginate*"; while the third includes detailed data on the water testing equipment, conductivity apparatus, proportioning pumps and chemical feeders offered by The Bird-Archer Company. Write for your copies—on your company letterhead, please. There is no cost, no obligation.

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Scientific Boiler Water Treatments
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4-BA-1

Carey HEAT INSULATIONS

helping bring the cost of KILOWATTS DOWN

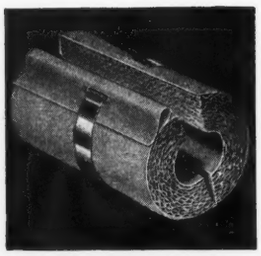
"In 1917, 3.5 pounds of coal were required to produce a kilowatt hour of electrical energy; in 1940, only 1.4 pounds were required."

* *As quoted from report of U.S. Bureau of Mines by Bituminous Coal Research.*

IN effecting this tremendous fuel saving, much credit unquestionably goes to improved engineering. Yet it is equally true that modern heat insulations, by eliminating excessive heat losses, are entitled to share the honors in this notable advance.

In reducing fuel consumption for American industry, CAREY Insulations are rendering outstanding service. It is a matter of record that these high-efficiency products usually pay back their cost in fuel savings in a fraction of a year, thereafter continue to return big annual dividends on the investment.

Carey Insulations and application practices are today so standardized that results, in the form of savings, are readily determined in advance. If you have an insulation problem, let Carey engineers inspect your plant and give an authoritative report. No obligation. For details address Dept. 16.



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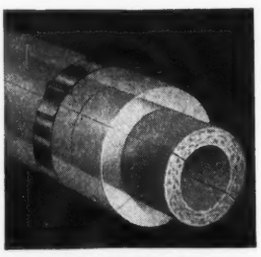
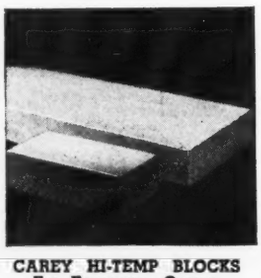
For Temperatures up to 300° F.

CAREY 85% MAGNESIA
For High and Medium Pressure
200° F. to 550° F.



COMBINATION HI-TEMP 85% MAGNESIA
500° F. to 1200° F.

CAREY HAIR FELT INSULATION
For Sub-Zero Temperatures



CAREY HI-TEMP BLOCKS
For Furnaces, Ovens, Kilns, etc.
1000° F. to 2500° F.

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WHERE CORROSIVE CONDITIONS ARE EXCEPTIONALLY

"TOUGH ON TUBES"...

PUT DURONZE IV TO THE TEST!

In seaboard power stations where such conditions as circulating brackish water, contaminating sewage, factory waste, silt and cinders raise havoc with practically every kind of condenser tubing, there exists a tremendous problem of tube maintenance that may be overcome by the use of condenser tubes made from DURONZE* IV.

For example, in a particular situation admiralty condenser tubes had failed in less than one year . . . aluminum brass and cupro nickel, although somewhat more durable, likewise were far from satisfactory. Then an experimental lot of DURONZE IV was tried out. It stood up best of all . . . and was remarkably free from thinning and pitting . . . resisting impingement corrosion and providing higher heat transfer value than certain other alloys.

A refractory alloy like DURONZE IV is difficult to produce quickly in times like these. However, it is available to be tried out experimentally for future use. Likewise, Bridgeport metallurgists and engineers are prepared to help you to evaluate accurately the conditions affecting your plant . . . to show how to get the best possible service from present tubing . . . or, if necessary, to recommend the proper tubing alloy as determined by the degree of severity of the corrosive conditions. There is no obligation in taking advantage of this opportunity to make sure the condenser or heat exchanger tubes are . . .

"ENGINEERED TO YOUR SERVICE REQUIREMENTS"

*Trade-name. U. S. Patent No. 2093380

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CAN YOUR PLANT STAND THE STRAIN?

Let's hope LESS and plan MORE — *Hoping* that our power plants survive the all-out effort ahead of us will not insure success. Foresight and careful planning to meet any contingency are absolutely essential *today*.

Modern boilers are tough . . . but 24-hour-a-day continuous operation at maximum capacity imposes a terrific strain, not only on boilers but on the auxiliaries upon which their successful operation depends.

Let's be realistic . . . increased production demands, fuel, labor turnover, outages and replacement difficulties are definite problems in your plant operation—and time is short!

This is how Hagan can help you

HAGAN Automatic Combustion Control provides a practical solution to many of the problems of continuous operation at peak capacity. For instance . . . you know that all adjustments will be made quickly and accurately, automatically removing the hazards of inexperienced personnel . . . you can be sure of uninterrupted operation and constant steam pressure, regardless of load demands. Hagan Control will carry on while operators are temporarily engaged in air raid drills and will operate the boilers at the right rate to carry the load.

With operating costs rising, you are assured that Hagan Control will produce the maximum amount of steam from every dollar's worth of fuel. In individual plants, fuel savings run as high as 6%.

With equipment replacements becoming increasingly difficult to obtain, the improved efficiency provided by Hagan Control reduces stoker outages and furnace maintenance, avoiding many unscheduled shutdowns and replacement delays.

In addition to the service it performs, you can rely on the Hagan Combustion Control system to remain on the job, year in and year out. Proper design, correct engineering and rugged construction make Hagan Control the logical choice today.

Now is the time for action. Write or wire us today! A thoroughly experienced Hagan combustion engineer will come at once to help you win your particular "battle of production." There's no obligation.

What you get with
HAGAN AUTOMATIC COMBUSTION CONTROL

Increased efficiency through correct proportioning of fuel and air.
Constant steam pressure.
Even distribution of load among boilers, or division as desired.
Maximum steam output per pound of coal.
Maximum efficiency even with inexperienced operators.
Fast, reliable operation without hunting.
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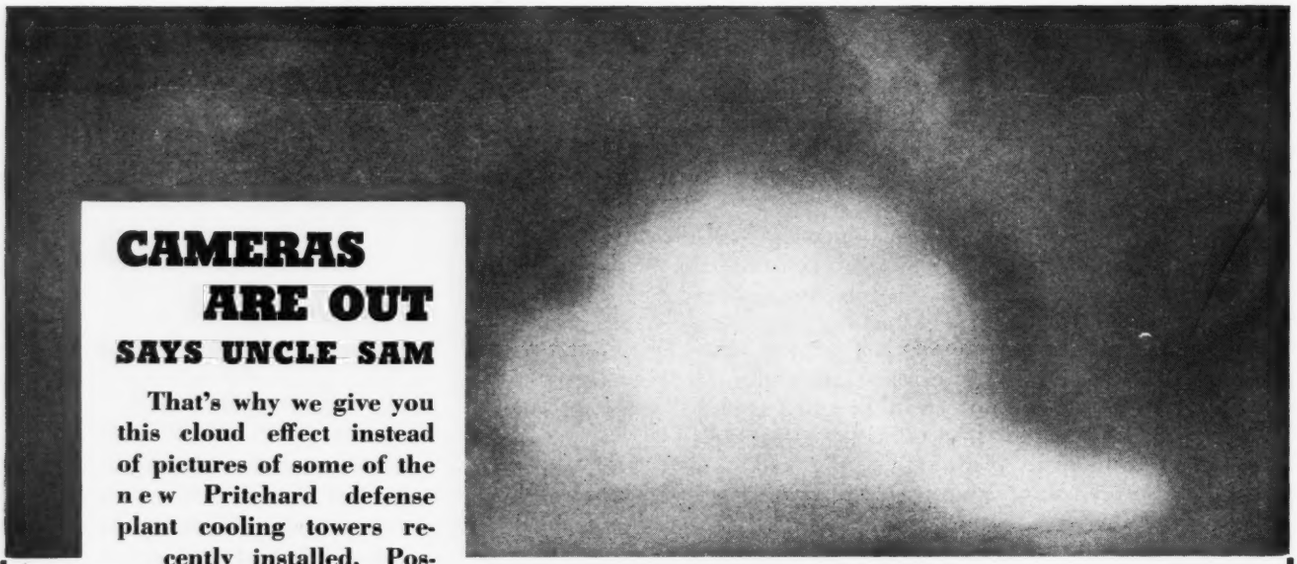
Elimination of smoke.
Lower power costs.
The engineering experience of the pioneers in automatic combustion control.

HAGAN CORPORATION · 300 ROSS STREET · PITTSBURGH, PA.

HAGAN *Automatic* COMBUSTION CONTROL
The pioneer . . . and still the leader



CAMERAS ARE OUT
SAYS UNCLE SAM

That's why we give you this cloud effect instead of pictures of some of the new Pritchard defense plant cooling towers recently installed. Possibly we can get the photos later.

BIG ORDERS FOR EFFICIENT EQUIPMENT

Very recently some of the largest cooling tower orders ever placed have been for Pritchard mechanical draft equipment.

These towers were bought on the basis of acceptable price, sound construction, economical operation and low cost per year of service, including both operation and maintenance.

Other buyers who want these advantages in water cooling equipment will always find them in Pritchard mechanical draft towers.

Bulletins 42 and 42-A tell you why. Write for them today.

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Dwight Building — Kansas City, Mo.

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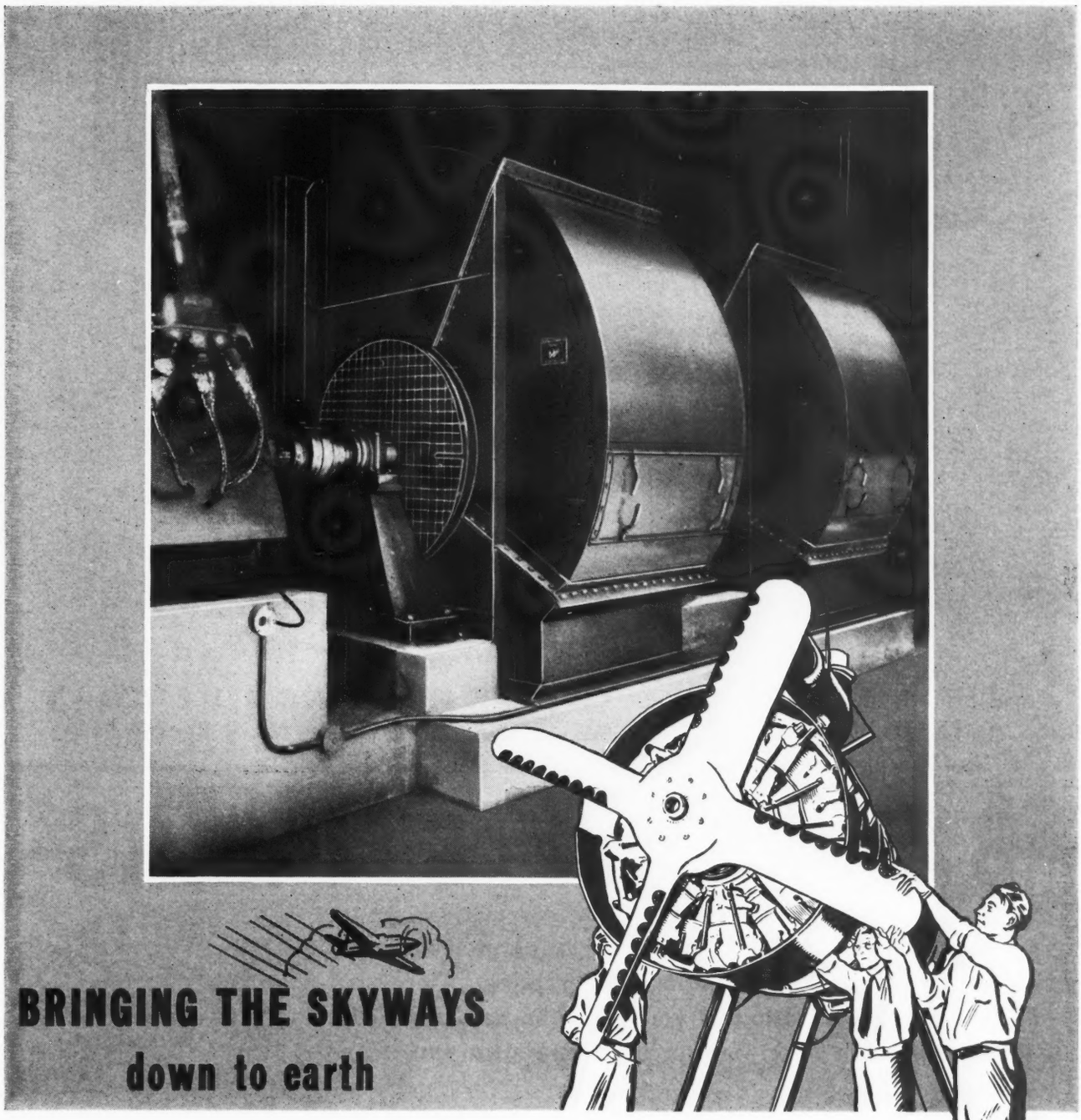
PRITCHARD

Atmospheric and Mechanical Draft

WATER COOLING TOWERS



BRINGING THE SKYWAYS down to earth

Air-cooled airplane engines depend upon the speed of flight—the wind velocity—to cool the cylinders. But what about this cooling in the research laboratory and on the test block? Buffalo Fans are solving this problem—actually duplicating, in the plant, wind velocities encountered in flight. With specially designed Buffalo Fans generating air streams that travel hundreds of miles per hour, engineers can accurately check an engine's efficiency and endurance before it leaves the ground! This special application of Buffalo Fans is but one of many Buffalo contributions to effective war production.

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MAKERS OF FINE
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DO NOT THROW AWAY YOUR WORN "TOLEDO" TOOLS OR DULL "TOLEDO" DIES

It is quite probable these worn tools can be repaired and the dull dies be resharpened to give additional service, conserving steel and other vital materials needed for war production.

WE SHALL WIN THIS WAR BUT TO WIN WE ALL MUST CO-OPERATE TO THE FULLEST EXTENT.

DO YOUR PART. SAVE—SAVE.

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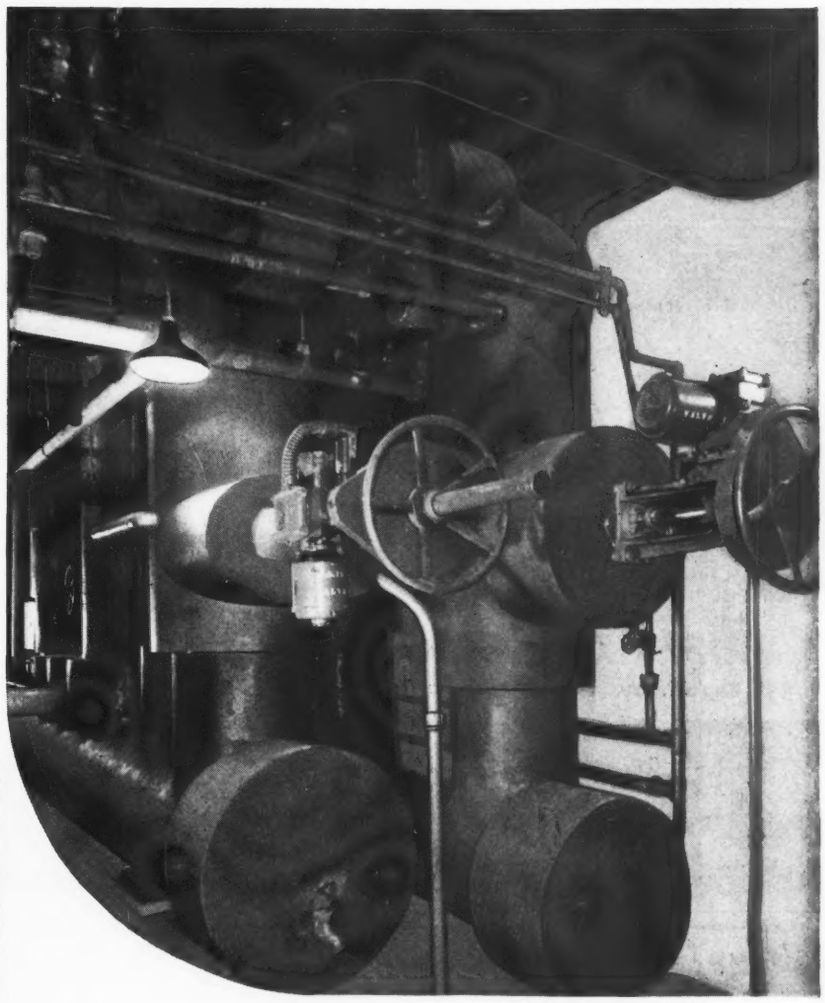
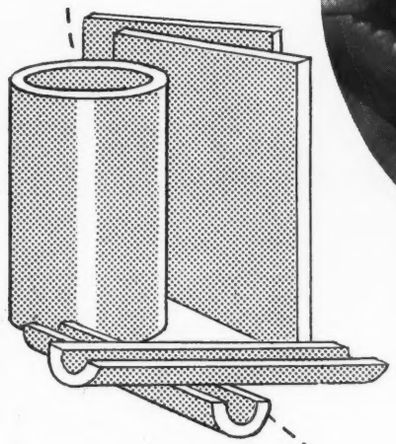
EFFICIENCY IN INSULATION: **unibestos**





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Half-section construction for all pipe sizes up to 36", thicknesses up to 5". Standard and Super material are available in single layer construction with provision for expansion in piping. Easily applied—saws or cuts clean and sharp with ordinary tools—easy to strip off layers to fit unions, flanges, etc. Won't soften, shatter or shake-down even under the most severe conditions. Write for the bulletin "They'll Specify Unibestos..." for complete table of sizes, list prices, etc.

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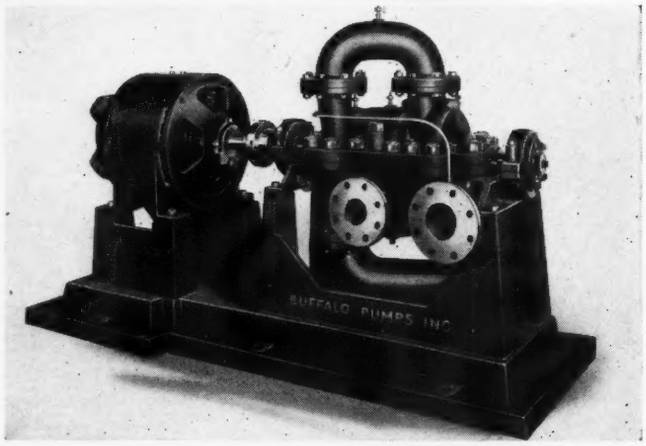
● Your ear quickly tells the story of the efficiency of Buffalo Type "RR" Pumps. The quiet, vibrationless operation—signals that here's a balanced design delivering full capacity with minimum friction and minimum power consumption.

And Buffalo "Type RR" Pumps keep right on with this efficient performance for years. Today, in general service duty in scores of plants, these husky pumps are proving the economy of relying on Buffalo!



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"Saving in coal more than repaid the cost of the VICTOR Damper Regulator in six months"

There are sizes and types of VICTOR Damper Regulators for every boiler room condition. The following, for example, is a typical letter from a user:

"In 1940 we installed one of your #501–8 VICTOR hydraulically operated damper regulators. We wish to take this opportunity to congratulate you upon your fine product. The saving in coal more than repaid the cost of the regulator during the first six months of its installation. Will you kindly inspect premises to determine the size and cost of a similar regulator for other steam boilers." (Name and details on request.)

This is VICTOR No. 501 for Vapor and Low Pressure Boilers

Make it your practice to put your regulating problems up to ATLAS — Standardize on ATLAS Regulating Valves.

For high pressures ask for VICTOR No. 503. For medium pressures — No. 502

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WE HAVE THEM FOR 4 WARS

Jarecki was nine years old when the Civil War began, 46 years old when the Spanish-American War opened and 65 years old when America entered the first World War. . . . And now, embarking on its 90th year, Jarecki has enlisted in still another war—the struggle of free men against the evil forces of oppression. .

In this struggle, as in previous wars, Jarecki's policy is clear-cut and plain: to place national interests first but at the same time to do our best, within the limits imposed upon us, to serve our civilian customers.

JARECKI
MANUFACTURING COMPANY
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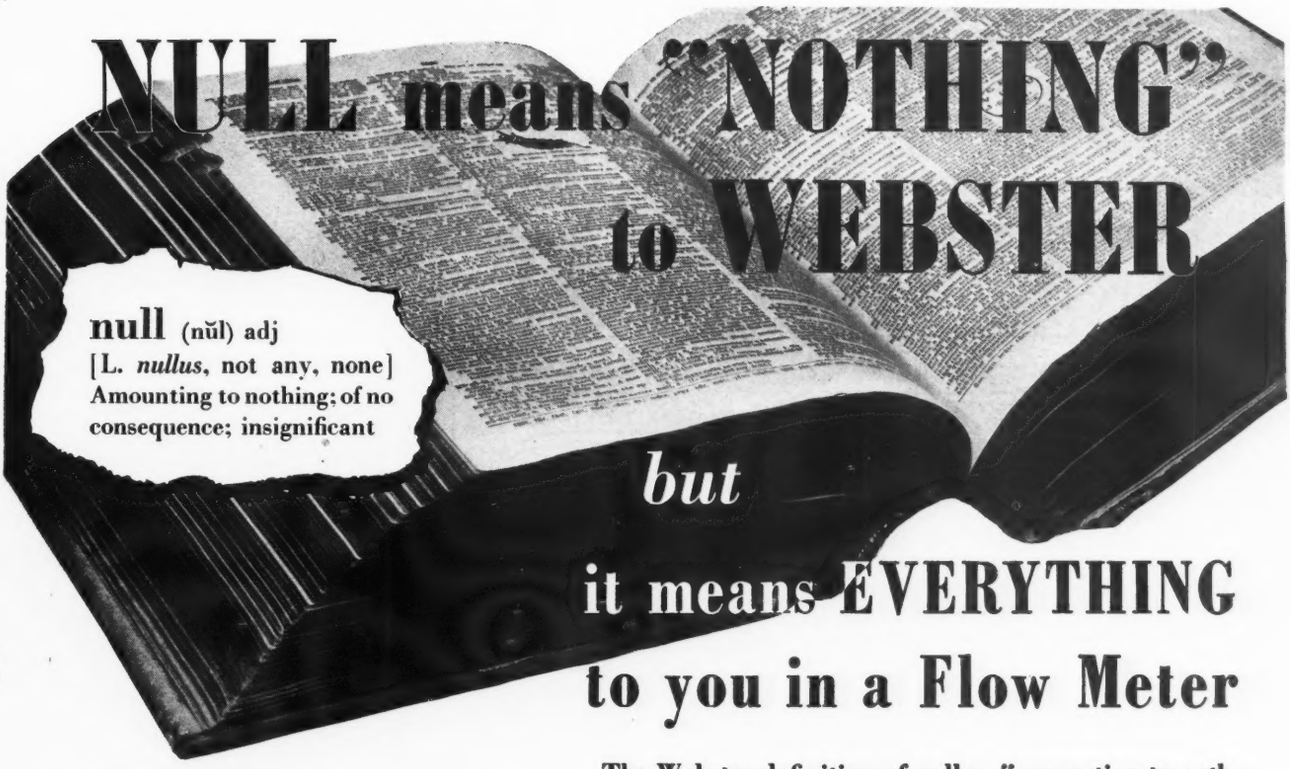
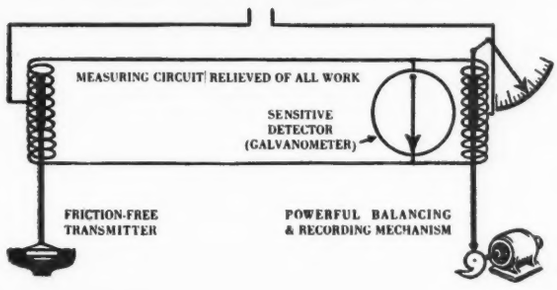
NULL means "NOTHING" to WEBSTER



but it means EVERYTHING to you in a Flow Meter

THE COCHRANE **NULL** BALANCE **PRINCIPLE**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FRICTION-FREE TRANSMITTER
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The Webster definition of null as "amounting to nothing" is the significant point in specifying a Cochrane Flow Meter, for Cochrane design is based on the NULL balance principle, long recognized as the most accurate means of measuring a force or quantity.

It means "zero" error in the measurement of flows, temperatures, liquid levels, pH values, etc.

The null or zero balance principle consists of balancing the unknown quantity by adjusting a known quantity of the same kind, a highly sensitive indicator being used to determine the point of balance.

It is the method used in the Cochrane Electric Flow Meter, distinguishing this meter from all others.

Note: a bridge circuit alone is *not* a null method meter. A galvanometer is required to detect unbalance and an external source of power is needed to restore balance. These are found ONLY in the Cochrane Electric Flow Meter.

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FLOW METERS

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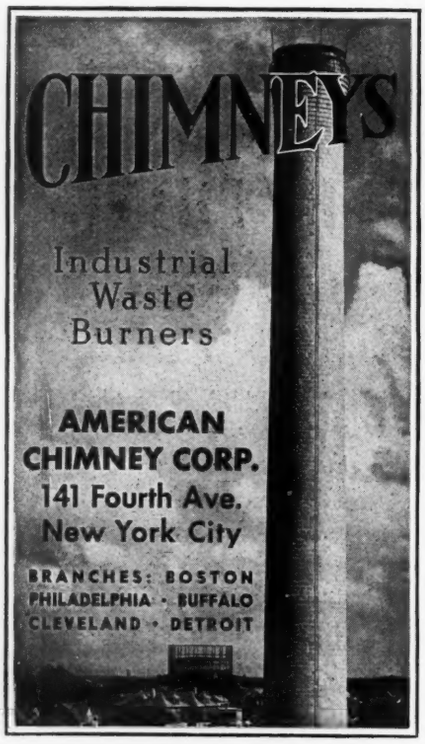
Featuring additional products and specialties for power plants



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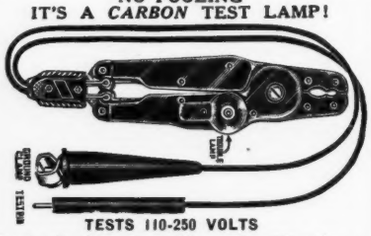

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Insulated pliers for testing and pulling fuses. Folding prongs fit base plugs. Test cord attachable. Model B tests 110-600 Volts.

Can be obtained from G.E.—Westinghouse, or other first class jobbers.

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SAVES $600.00
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WHERE TO BUY
Section

supplements other advertising in this issue with these additional announcements of products and services essential to efficient and economical power operation and maintenance. Make a habit of checking this page, each issue.

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OPERATING ENGINEER, 20 years experience 10,000 KW Station as Chief Engineer, Operation, Maintenance and installation, 2.3-6.9 33. and 66. K.V. substation Utility and Industrial Plants. Powered Fuel and miscellaneous Stokers. Age 42. A1 references. PW-267, Power, 520 N. Michigan Ave., Chicago, Ill.

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SALES ENGINEER wanted. We have openings in various territories for salesmen with several years' selling experience; knowledge of boilers and power plant equipment and acquaintance with engineers and industrial buyers. Permanent profitable repeat business. We may not be represented in your territory. Write us full details as to your qualifications. SW-263, Power, 520 N. Michigan Ave., Chicago, Ill.

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F-M DIESEL SET—120 H.P. Heavy Duty Generating Units: 76 KW 3 phase 60 cycle 240 volts. Can be reconnected 480 volts. This unit has had one year actual service and is in perfect condition. Available immediately. Located near Chicago. Address FS-264, Power, 520 N. Michigan Ave., Chicago, Ill.

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SECOND-HAND WOOD GRINDERS, approximately one hundred ton capacity with motors. W-242, Power, 520 N. Michigan Ave., Chicago, Ill.

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WANTED
GENERATOR SET
250 KW, 3 Phase, 60 Cycle, 220 V., 4 Wire. Engine must be upright.
QUICK SERVICE LDRY. #1 INC.
315 E. 99th St. New York City

WANTED
Steel Smokestack
8 ft. diameter, or larger, at least 125 ft. high. For operation.
W-258, Power
68 Post St., San Francisco, Calif.

WANTED
1000 KW Rotary 250 v DC 3 ph trans 11000 v.
100, 200, 300, 500 & 800 KW MG's 250 v DC syn.
1000 KW MG 250 v DC 2300 v. syn. a.c.
75 HP 4-valve non-releasing Corliss engine.
1000 HP .8 .9 3/60/2300 720 RPM.
1000 KW mercury arc rect. 2200 AC 250 DC
2000/3000 HP syn. 200/240 RPM 3/60/2300
600 KW 250 v DC gen. 900 RPM syn.
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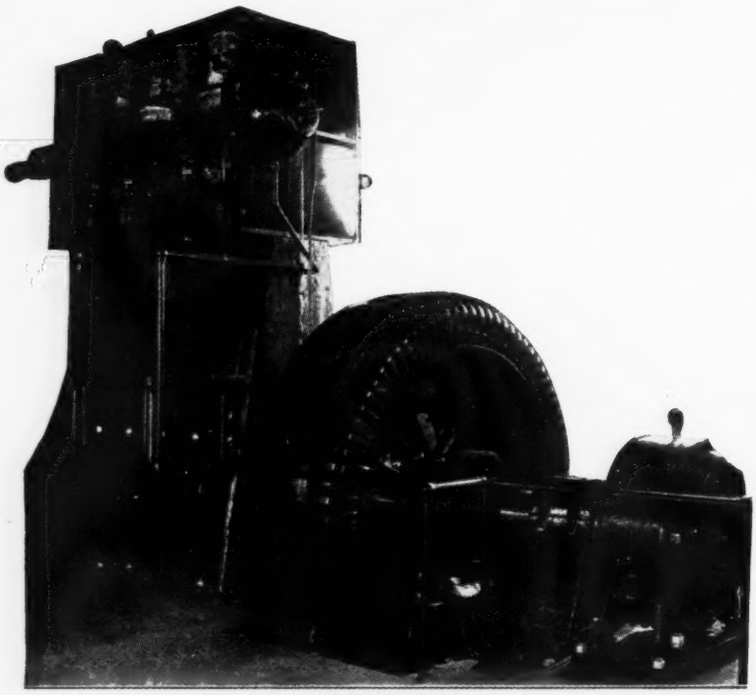


Actual Photograph

625 KVA AMES VERTICAL UNIFLOW UNIT

625 KVA Westinghouse alternating current generator, 3 phase 60 cycle 2300/600/480/240 volts 300 RPM direct connected to 14"x16" Ames 4 cylinder vertical uniflow non-condensing engine, 150-175 lbs. steam pressure 0-5 lbs. back pressure. Complete with exciter and switchboard

Can be shown in operation

ENGINE GENERATORS

3 Phase 60 Cycle

625 KVA WESTINGHOUSE - AMES 4 cylinder vertical Uniflow, 150-175 lbs. 0-5 lbs. back pressure, 2300/600/480/240 volts.

500 KVA GENERAL ELECTRIC-AMES 4 cylinder vertical Uniflow, 150-175 lbs., 0-10 lbs. back pressure, 2300/600/480/240 volts.

210 KVA GENERAL ELECTRIC-AMES Uniflow, 125-150 lbs., 0-5 lbs. back pressure, 2300/-600/480/240 volts.

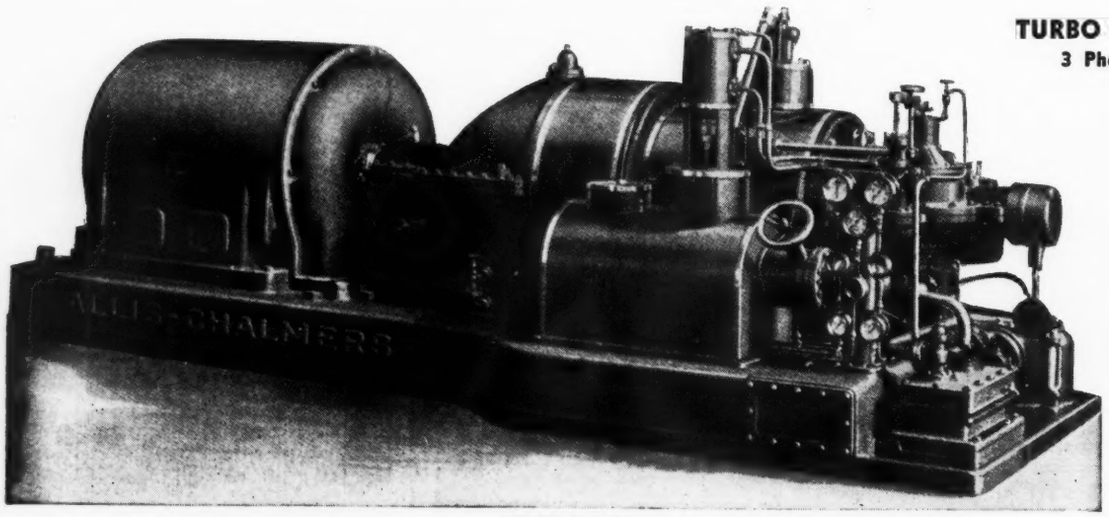
210 KVA (2) GENERAL ELECTRIC - SKINNER Uniflow, 125-150 lbs., 0-5 lbs. back pressure, 2300/600/480/240 volts.

VERTICAL UNIFLOW ENGINE GENERATORS

125/250 Volts 3-Wire D.C.

150 KW CROCKER WHEELER-AMES 3 cylinder vertical uniflow, 250 lbs. 0.8 lbs. back pressure.

125 KW CROCKER WHEELER-AMES 3 cylinder vertical uniflow, 250 lbs. 0.8 lbs. back pressure.



Actual Photograph

1000 KW ALLIS CHALMERS CONDENSING TURBO UNIT

1000 KW 80% P.F. 1250 KVA Allis Chalmers alternating current generator 3 phase 60 cycle 2300 volts 3600 RPM direct connected to 1000 KW Allis Chalmers condensing turbine 150-200 lbs. steam pressure 100 deg. superheat. Equipped with jet condenser and auxiliaries.

TURBO GENERATORS

3 Phase 60 Cycle

2500 KVA GENERAL ELECTRIC condensing, 150 lbs., with barometric condenser; 2300 volts.

1250 KVA ALLIS CHALMERS condensing, 150-200 lbs., 500 deg. TT, with jet condenser; 2300 volts.

187½ KVA WESTINGHOUSE non-condensing, 175 lbs. presure, 0-24 lbs. back pressure; 240 volts.

THE NATIONAL POWER

ER EQUIPMENT

ROTARY CONVERTERS

60 Cycle

3500 KW (2) WESTINGHOUSE, 225-285 volts D.C., 225 RPM with 3 phase 60 cycle 13200 volt transformers.

2500 KW WESTINGHOUSE, 600 volts D.C., 400 RPM with 3 phase 60 cycle 11000 volt transformer.

1500 KW WESTINGHOUSE, 225-285 volts D.C., 450 RPM with 3 phase 60 cycle 2300/4000-6900/12000 volt transformers.

750 KW GENERAL ELECTRIC, 600 volts D.C., 1200 RPM with 3 phase 60 cycle 2300/4000 volt transformers.

500 KW WESTINGHOUSE, 600 volts D.C., 1200 RPM with 3 phase 60 cycle 13200 volt transformer.

300 KW WESTINGHOUSE 600 volts D.C., 1200 RPM with 3 phase 60 60 cycle 13200 volt transformers.

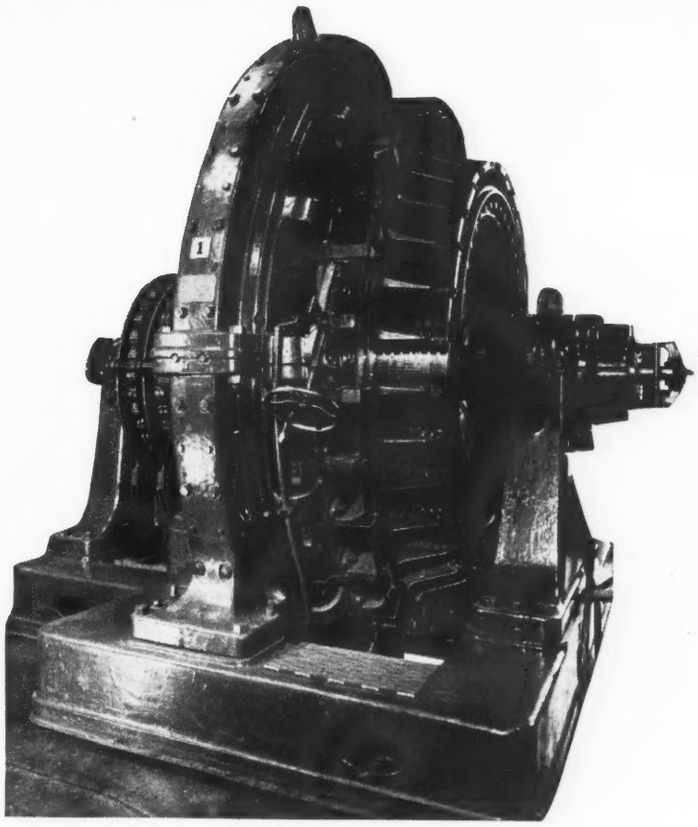
300 KW WESTINGHOUSE, 250 volts D.C., 600 RPM with 3 phase 60 cycle 2300 volt transformers.

ROTARY CONVERTERS

25 Cycle

1500 KW WESTINGHOUSE, 600 volts D.C., 500 RPM with 3 phase 25 cycle 11,000 volt transformer.

1000 KW GENERAL ELECTRIC, 600 volts D.C., 750 RPM with 3 phase 25 cycle 11,000 volt transformer.



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3500 KW WESTINGHOUSE ROTARY CONVERTER

3500 KW (2) Westinghouse booster type interpole rotary converters, 225-285 volts D.C. 225 RPM; 6 phase 60 cycle A.C. with 3 phase 60 cycle 13200 volt transformers. Complete with control.

Can be shown in operation

MOTOR GENERATOR SETS

3 Phase 60 Cycle

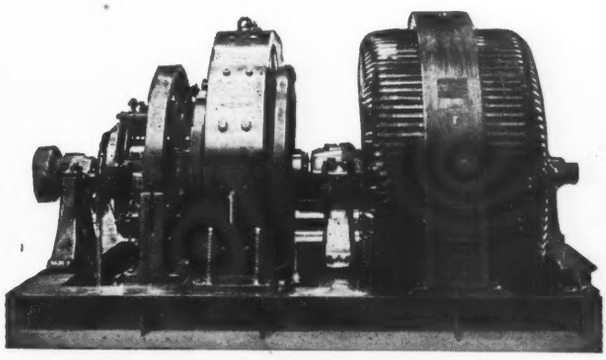
1000 KW GENERAL ELECTRIC synchronous, 125-250 volts 3-wire D.C.; 3 phase 60 cycle 13200 volts A.C., 720 RPM.

750 KW GENERAL ELECTRIC synchronous, 600 volts D.C., 3 phase 60 cycle 2300 volts A.C., 720 RPM.

400 KW GENERAL ELECTRIC induction, 250 volts D.C., 3 phase 60 cycle 2200 volts A.C., 600 RPM.

150 KW WESTINGHOUSE synchronous, 250 volts D.C., 3 phase 60 cycle 2300 volts A.C., 900 RPM.

100 KW WESTINGHOUSE synchronous, 125 volts D.C.. 3 phase 60 cycle 220 volts A.C., 1200 R.P.M.



Actual Photograph

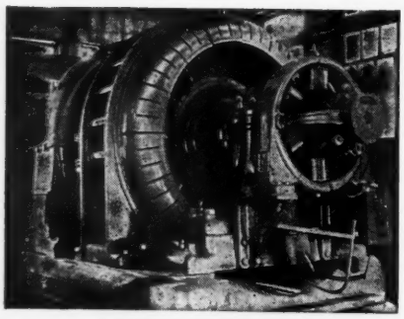
1000 KW GENERAL ELECTRIC MOTOR GENERATOR SET

1000 KW GENERAL ELECTRIC direct current generator, 125/250 volts, 3-wire, 720 RPM., direct connected to 1400 HP 80% P.F. General Electric synchronous motor, 3 phase 60 cycle 13200/6600 volts, 720 RPM. Equipped with D.C. breakers. Can be shown in operation.

MACHINERY CO. 1921 SCRANTON RD. CLEVELAND, OHIO

AVOID DELAY...

Step up your Power



MOTOR GENERATOR SETS

1—500 KW, 125/250 volt, 3-unit, General Elec., synchronous.
1—500 KW, 650 volt, General Electric, syn.
1—300 KW, 250 volt, General Electric, syn.
1—100 KW, 250 volt, synchronous.
1—100 KW, 125 volt, Westinghouse, syn.
1—100 KW, 125/250 volt, Allis Chalmers, squirrel cage.
1—50 KW, 250 volt, General Electric, sq. cg.
1—35 KW, 125 volt, El. Mach., sq. cg.
1—25 KW, 125 volt, General Electric, syn.
1—20 KW, 125 volt, Burke, squirrel cage

D. C. GENERATORS

1—100 KW, 750 RPM, 125 volt, West. Elec.
1—100 KW, 600 RPM, 125/250 volt, G.E.
1—75 KW, 260 RPM, 250 volt, Westinghouse.
1—67½ KW, 700 RPM, 45 volt, Gen. Elec.
2—32 KW, 650 RPM, 125 volt, Westinghouse.

MOTORS—3 PHASE 60 CYCLE

1—720 HP, 360 RPM, 440 volt, G.E., syn.
1—500 HP, 450 RPM, 2200/4000 volt, G.E., slip ring.
1—400 HP, 514 RPM, 440 volt, Westg., sl. rg.
1—350 HP, 300 RPM, 440 volt, G.E., slip ring.
1—350 HP, 100 RPM, 220/440 volt, G.E. syn.
1—335 HP, 600 RPM, 2300 volt, G.E., syn.
1—250 HP, 450 RPM, 220 volt, G.E., slip ring.
1—250 HP, 360 RPM, 440 volt, Westg. sq. cg.
1—250 HP, 514 RPM, 4000 volt, G.E., syn.
1—200 HP, 900 RPM, 440 volt, Westg., sl. rg.
1—200 HP, 600 RPM, 2200 volt, G. E., sl. rg.
1—200 HP, 450 RPM, 2200/4000 v., G.E., sl. rg.
1—200 HP, 514 RPM, 4000 volt, G.E., syn.
1—175 HP, 900 RPM, 440 volt, Westg. syn.
1—150 HP, 1800 RPM, 2300 volt, Allis Chal. sq. cg.
1—150 HP, 900 RPM, 440 volt, Allis Chal. sl. rg.
2—150 HP, 720 RPM, 220 v., Elec. Mach. syn.
1—150 HP, 720 RPM, 440 volt, G E., slip ring.
1—150 HP, 600 RPM, 440 volt, G.E., slip ring.
1—150 HP, 400 RPM, 440 volt, G.E., sq. cg.
2—125 HP, 720 RPM, 440 volt, G.E., slip ring.
2—125 HP, 450 RPM, 440 volt, G.E., syn.
1—100 HP, 1800 RPM, 440 v., Allis Chal. sq. cg.
1—100 HP, 900 RPM, 220 volt, G.E., sq. cg.
1—100 HP, 900 RPM, 440 volt, G.E., slip ring.
3—100 HP, 720 RPM, 440 volt, G.E., slip ring.
1—100 HP, 720 RPM, 440 volt, G E., sq. cg.
1—100 HP, 600 RPM, 440 volt, G.E., slip ring.
1—100 HP, 600 RPM, 440 volt, G.E., sq. cg.

MOTORS—3 PHASE 60 CYCLE—(Continued)

1—100 HP, 514 RPM, 440 volt, G.E., sq. cg.
2—100 HP, 450 RPM, 440 volt, G. E., sq. cg.
1—75 HP, 1800 RPM, 220/440 v., G. E., sq. cg.
1—75 HP, 900 RPM, 4000 v., Elec. Mach. syn.
1—75 HP, 900 RPM, 440 volt, G.E., enclosed, fan cooled, squirrel cage.
1—75 HP, 900 RPM, 220 volt, Fairbanks-Morse, slip ring.
1—75 HP, 900 RPM, 2200 volt, G.E., slip ring.
1—75 HP, 514 RPM, 440 volt, G.E., sq. cg.
1—60 HP, 1750 RPM, 220 volt, G.E., sq. cg.

MOTORS—D. C. 230 VOLTS

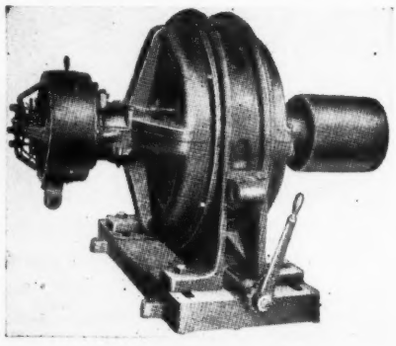
1—125 HP, 850 RPM, G.E., type CD.
1—125 HP, 550 RPM, General Electric.
1—100 HP, 1600 RPM, West., type SK.
1—65 HP, 1000 RPM, G. E., type RC.
1—50 HP, 1750 RPM, Westinghouse, type SK.
1—50 HP, 1100 RPM, Crocker Wheeler.
1—50 HP, 750 RPM, Westinghouse, type SK.
1—50 HP, 700 RPM, Crocker Wheeler.
1—40 HP, 1100 RPM, G.E., type RC.
1—40 HP, 300 RPM, General Electric.
1—30 HP, 750 RPM, G.E., type RC.
1—30 HP, 725 RPM, Westinghouse, type SK.

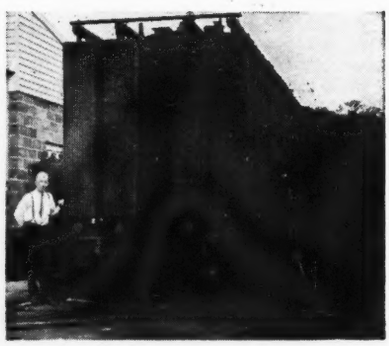
TURBO-GENERATORS

2—1000 KW, 3 ph., 60 cy., 2300/4150 v., cond.
1—625 KVA, Westinghouse, non-condensing.
1—500 KW, G E., 3 ph., 60 cy., 480 volt, bleeder.
1—375 KVA, Westinghouse, non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 v. cond.
1—200 KW, G.E., 3 ph., 60 cy., 220 volt, cond.
1—150 KW, 125/250 volt, Westg., non-cond.
1—100 KW, 125 volt, Westg., non-cond.
1—25 KW, 125 volt, Ridgeway, non-cond.

MOTORS—VARIABLE SPEED 230 VOLTS

2—100 HP, 475/1375 RPM, Electro Dynamic
1—90 HP, 470/940 RPM, General Electric.
1—75 HP, 525/1575 RPM, Electro Dynamic.
1—75 HP, 235/950 RPM, Burke.
1—60 HP, 600/1200 RPM, General Electric.
1—30 HP, 225/900 RPM, Crocker Wheeler.
1—20 HP, 750/1500 RPM, General Electric.
1—5 HP, 600/1200 RPM, General Electric.
6—5 HP, 400/1200 RPM, Westinghouse.
1—5 HP, 225/900 RPM, Electro Dynamic.
1—5 HP, 600/1800 RPM, General Electric.





▶15,000 KVA Allis Chalmers, 3 phase 27,000 to 4000 V.

TRANSFORMERS

1—15,000 KVA, Pitts., 3 ph., 26,000/4150 v.
4—833 KVA, Allis Chal., 25 cy., 13,200/440 v.
3—400 KVA, Moloney, 13,800-220/440 volts.
2—400 KVA, G.E., 4156-240/480 v., Scott taps.
3—300 KVA, Pittsburgh, 7800/440 volts.
3—300 KVA, Pittsburgh, 4600-115/230 volts.
4—200 KVA, Pittsburgh, 7800-110/220 volts.
3—150 KVA, G.E., 33,000-2300/4000 Y.
3—150 KVA, Pittsburgh, 6600/440 volts.
12—150 KVA, G.E., 3 ph., 4150-120/208 v.
3—125 KVA, General Electric, 2300/480.
3—100 KVA, Westinghouse, 13200 250 volts.
3—100 KVA, G.E., 2400-240/480 volts.
3—100 KVA, Wagner, 2300-240/120 volts.
1—75 KVA, Pittsburgh, 7600-110/220 volts.
3—50 KVA, Wagner, 4150-220 volts.
3—50 KVA, Westinghouse, 2200-220/110 volts.
4—50 KVA, Westg., air cooled, 440-220/220-110 v.
3—50 KVA, Westinghouse, 220-110/220 volts.
3—50 KVA, G.E., 2200-110/220 volts.
52—37½ KVA, 2200-220/110 v
10—25 KVA, Westg., air cooled, 440/220-110 v.
3—25 KVA, Moloney, 2200-220/110 volts.
1—25 KVA, G.E., 220/110-220/110 volts.
2—15 KVA, G.E., 2300-115/230 volts.
1—15 KVA, G.E., 440/110-220 volts.
12—15 KVA, Westg., air cooled, 440/220-220-110 v.
4—10 KVA, G. E., 2300-115/230 volts.
3—7½ KVA, G.E., 440-110/220 volts.

OIL CIRCUIT BREAKERS

2—3000 amp., 15,000 v., 3 pole, G.E., type FK-130.
1—3000 amp., 600 v., 4 pole, G.E., type FK-24.
2—2000 amp., 15,000 v., 3 pole, G.E., type FK-53b.
1—1600 amp., 7500 v., 4 pole, Westg., B-2.
1—1500 amp., 440 v., 3 pole, Condit, D12.
1—1200 amp., 15000 v., 4 pole, Westg., B-2.
Also complete stock of small sizes.

ALTERNATORS

1—625 KVA, 450 RPM, 600 volt, Westg.
1—625 KVA, 3600 RPM, 600 volt, G.E.
1—400 KVA, 400 RPM, 240 volt, Westg.
1—375 KVA, 240 RPM, 2300 volt, Westg.
1—375 KVA, 200 RPM, 240 volt, Elec. Mach.
1—250 KVA, 720 RPM, 230 volt, G.E.
1—200 KVA, 3600 RPM, 240 volt, Allis Chal.
1—100 KVA, 1200 RPM, 440 volt, G.E.
1—37½ KVA, 1200 RPM, 2400 volt, Westg.
1—15 KVA, 1800 RPM, 120 volts, G.E.

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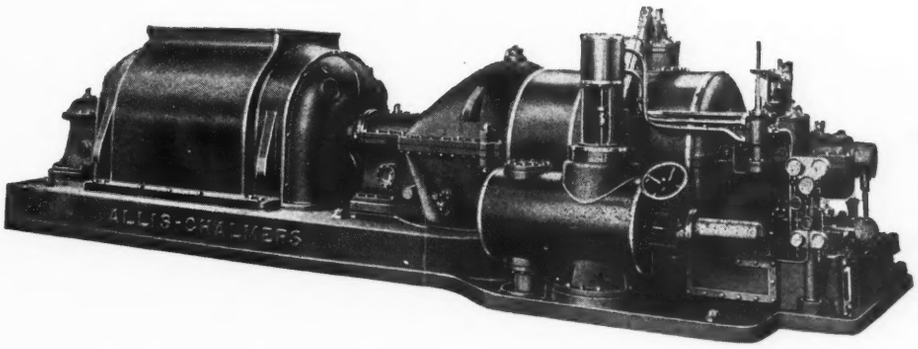
DEPENDABLE

Turbo-Generators

It is the Practice of this Company to Confine its Inventory Strictly to Comparatively Modern, Little Used Turbines Some Are Practically New



2—Allis-Chalmers, 2500-KVA, 3/60/2300-volt, 200#-P, 500°F-TT, Surface Condensers

PART OF OUR INVENTORY—BELOW

1—G.E., 7500-KVA, 3/60/600-2300-v, 250# 575° Maximum. Surface Condenser.

1—Allis-Chalmers 4000-KVA, 3/60/2300-v, 200#, 500°-F, TT, Condensing.

1—G.E., 1875-KVA, 3/60/480-v, 200#, 500°, Condensing.

1—G.E., 1563-KVA, 3/60/2300-v, 175#, 100° SH, 28". Surface Condenser.

1—Westinghouse, 1563 KVA, 3/60/2400 volts, 200#, 100° SH. Condensing, Modern.

1—Westinghouse 1000-KW, 250-volt, Direct Current, Condensing, 150/200# pressure. Surface Condenser.

1—Allis-Chalmers 1250-KVA, 3/60/2300-v, 200#, 500° TT. Surface Condenser.

1—G.E., 1250-KVA, 3/60/480-v, 175#-P and 16# Abso. Mixed Pressure.

1—G.E., 937-KVA, 3/60/2300-v, 200#, 500°-TT, 3-Stage Condensing.

1—Allis-Chalmers, 937-KVA, 3/60/2300-v, 200#, 500°-TT, Condensing Surface Condenser.

1—G.E., 625-KVA, 3/60/2300-v, 200#, 500°TT. Condensing.

1—G.E., 625-KVA, 3/60/600-v, 250#, 550°F-TT, Condensing Modern.

WILMS, WEAVER & CO. Union Guardian Bldg. DETROIT, MICH.

We Deal In Turbo-Generators Exclusively

THE PICK OF POWER EQUIPMENT

TURBO UNITS—60 CY.

1—4000 KVA Allis Chalmers Cond.
1—3125 KVA General Electric Cond.
1—2850 KVA Westinghouse Cond.
1—2500 KVA General Electric Cond.
1—1563 KVA General Electric Cond.
1—1250 KVA General Electric Cond.
1— 937 KVA General Electric Cond.
1— 750 KVA Terry Double Extr. Cond.
3— 625 KVA General Electric Cond.
1— 625 KVA General Electric Extr. Cond.
1— 375 KVA General Electric Cond.
1— 250 KVA General Electric Cond.
1— 938 KVA West. 375# I.P. 100# B.P. N-C.
1— 375 KVA General Electric Non-C.
1— 312 KVA Moore Non-Condensing
2— 156 KVA Allis Chalmers Non-C.
1— 125 KVA Westinghouse Non-C.

STEAM ENGINE UNITS—60 CY.

1—1067 KVA Nordberg Uniflow
1—1000 KVA Skinner Uniflow
2— 937 KVA Nordberg Uniflow
1— 500 KVA Rice & Sargent Corliss
1— 425 KVA Hamilton Poppet Valve
1— 325 KVA Skinner Uniflow
1— 312 KVA Fitchburg 4-valve
1— 250 KVA Harrisburg Uniflow
1— 150 KVA Hamilton Poppet Valve

DC STEAM ENGINE UNITS

1—500 KW Skinner Uniflow 250 V.
1—400 KW Mesta Uniflow 250 V.
1—300 KW Skinner Uniflow 250 V.
1—300 KW Chuse 4-valve 250 V.
2—250 KW Skinner Uniflow 250 V.
1—200 KW Chuse 4-valve 250 V.
2—150 KW Erie Ball 4-valve 250 V.
1—150 KW Ames Uniflow 125/250 V. vertical
1—150 KW Ames Uniflow 125 V.
1—125 KW Ames Uniflow 125/250 V. vertical
1—100 KW Ames Uniflow 120 V.
1— 75 KW Skinner Uniflow 250 V.
1— 50 KW Ames Uniflow 125/250 V. 3-wire

OIL & GAS ENGINE UNITS—60 CY.

1—1000 KVA Nelseco Diesel 2300 V.
1— 613 KVA Fair.-Morse 480 V.
1— 375 KVA Cooper-Bess. 2300 V.
1— 75 KVA Ing.-Rand 2300/440/220 V.
1— 300 KW West. (gas) 440 V.
1— 237 KVA Fair.-Morse 480 V.
1— 210 KVA Natl. Superior 440/220 V.
1— 200 KVA Fair.-Morse 2400/440/220 V.
1— 100 KVA Buckeye 240/480 V.
1— 75 KW Anderson type K 2300 V.

WATER TUBE BOILERS

6—600 HP Stirling 180-lb. Stokers
2—520 HP Heine 200-lb. Hand Fired
1—512 HP Erie City 175-lb. Oil Burner
2—511 HP Union 200-lb. Stokers
1—500 HP B. & W. 200-lb. Stoker
2—407 HP Erie City 250-lb. Stokers
6—400 HP B. & W. 200-lb. Hand Fired
1—389 HP Stirling 200-lb. Stoker
2—357 HP Casey-Hedges 175-lb. Stokers
1—325 HP Stirling 160-lb. Stoker
2—282 HP Edge Moor 200-lb. Stokers
2—254 HP Stirling 180-lb. Stokers
2—160 HP Stirling 155-lb. Hand Fired

SYNCHRONOUS CONDENSERS

1—4000 KVA G. E. 13200 V. 514 RPM
1—2000 KVA G. E. 11000/2200 V. 720 RPM
1—2000 KVA C. W. 11000 V. 600 RPM
1—1000 KVA G. E. 2300 V. 900 RPM
1— 500 KVA West. 2200 V. 900 RPM

SYNCHRONOUS MOTORS—60 CY.

2—800 HP Electric Machy. 6600 V. 450 RPM
1—500 HP General Electric 440 V. 360 RPM
1—225 HP General Electric 2200 V. 225 RPM
2—200 HP General Electric 440 V. 277 RPM
1—175 HP General Electric 440 V. 277 RPM
1—100 HP General Electric 440 V. 277 RPM

OIL CIRCUIT BREAKERS

1—800 A. 87 KV Am.Br.Bov. AF22 Outdr.
2—600 A. 30 KV Keiman CB-76 Outdoor
1—400 A. 25 KV G. E. FKO136 Outdoor
4—400 A. 25 KV Condit D-16-A Outdoor

FREQUENCY CHANGERS

2—3125 KVA West. 25/62½ cy. 750 RPM
1—3000 KVA West. 60/25 cy. 300 RPM
1—2500 KVA West. 25/60 cy. 300 RPM
1—1500 KW G. E. 25/60 cy. 300 RPM
1—1250 KVA G. E. 25/62½ cy. 375 RPM
1—1000 KVA G. E. 60/25 cy. 514 RPM
2— 750 KVA G. E. 25/60 cy. 300 RPM
1— 500 KVA G. E. 25/60 cy. 300 RPM

ROTARY CONVERTERS—60 CY.

2—1000 KW General Electric, 600 V.
1— 500 KW General Electric, 250 V.
1— 500 KW General Electric, 600 V.
2— 300 KW General Electric, 600 V.

TRANSFORMERS—1 PH. 60 CY.

3— 600 KVA West. 120,000/2300 V.
2— 1000 KVA West. 66000/2300 V.
1— 1000 KVA Wagner 33000/2300 V.
3— 500 KVA Allis 33000/480 V.
2— 1000 KVA G. E. 23000-11500/575 V.
3— 100 KVA G. E. 22000/6900 V.
1—10000 KVA Pitts. 13200/4600 V. 3 ph.
2— 5000 KVA American 13800/2300 V.
5— 1000 KVA G. E. 13800/2300 V.
1— 450 KVA G. E. 13210/240-480 V. 3 ph.
4— 200 KVA West. 13200/2300-4000 V.
3— 150 KVA Pitts. 13800/230-460 V.
3— 75 KVA West. 13800/230-460 V.
3— 150 KVA Pitts. 11000/2400 V.
3— 100 KVA West. 11000/250-125 V.
2—3300 KVA G. E. 6600/110 V. 3 ph. Furnace
3—1250 KVA G. E. 6600/550 V.
3— 100 KVA G. E. 6900/440-220 V.
3— 833 KVA Penn. 4800/120-240 V.
3—1500 KVA West. 2300/106 V. 3 ph. Furnace
3—1000 KVA Pitts. 2300-4600/550 V.
3— 75 KVA Wagner 2300/230-460 V.
3— 50 KVA G. E. 2400/240-120 V.
3— 50 KVA Wagner 2400/480-240 V.

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & Co., INC.

50 CHURCH STREET, NEW YORK CITY

SUCCESSFUL OPERATION GUARANTEED

Every Machine in This Ad is Owned Outright By Us

D C MOTORS

230 Volt—Constant Speed

	HP	Make	Type	Speed
1—	300	Cr. Wh.	CCM-108H	550
1—	250	Al. Ch.		525
2—	200	Whse.	SK	400
1—	200	G.E.	DMC	475
1—	150	G.E.	MPC	275
1—	140	G.E.	MDS-108	410
1—	125	G.E.	CDP-123	1750
3—	100	G.E.	LC-50	1200
1—	100	G.E.	RC-38	600

230 Volt—Adjustable Speed

1—	600	Whse.		150/275
1—	300	G.E.	MPC	250/400
1—	300	G.E.	MPC	275/550
2—	275	G.E.	DMC	500/750
1—	200	Whse.		400/500
1—	150	G.E.	MPC	250/450
1—	100	Al.Ch.		950/1150
1—	75	Whse.	SK	475/900
1—	75	G.E.	CD-145	575/865
1—	75	Cr.Wh.	65H	600/1200
1—	75	G.E.	C	500/1000
2—	60	El.Dy.	S	525/1050
2—	50	Cr.Wh.	CMC-81H	300/900
1—	45	G.E.	CD-125	450/1350
24—	30	Whse.	SA	500/1500
1—	25	Cr.Wh.	50H	335/1000

TRANSFORMERS

	KVA	Make	Ph.	Type	Voltages
1—	1500	Whse.	3	OISC	26400/13200x460
3—	1000	G.E.	1	HKDD	13800x2300
3—	333	Pitts.	1	OISC	13800x440/220
3—	300	G.E.	1	H	13200x2300/575
3—	300	Pkd.	1	OISC	2300x460
2—	200	Whse.	1	SK	6900x230/460
3—	200	G.E.	1	H	26400x115/460
3—	100	Whse.	1	OISC	13200x250

ENGINE GENERATOR SET

1—100 KW, Whse. D.C. Gen. 125/250 v. 3 wire 250 R.P.M. dir. Conn. 150 H.P., 14x15 Skinner steam engine 150# press

MOTOR GENERATOR SETS

3 phase—60 cycles

1—1500 KW Whse. 250 V. Gen. d.c. to 2100 HP 2200/4400 V. syn. motor.
1—1500 KW G.E. 600 v. Gen. d.c. to 2100 HP 6600 v. syn. motor.
1—500 KW G.E. 600 v. Gen. d.c. to 700 HP 13200 v. syn. motor
1—500 KW G.E. 600 v. Gen d.c. to 700 HP 2300 v. syn. motor
1—300 KW G.E. 600 v. Gen d.c. to 435 HP 10000 v. syn. motor
1—250 KW G.E. 275 v. Gen d.c. to 350 HP 4600 v. syn. motor
1—200 KW Al. Ch. 3 units; 2—100 KW 250 v., Gen. d.c. to 220 KVA 2200 v. syn. motor.

TURBO GENERATOR SET

1—500 KW, Whse., 625 KVA, 480 v., 3 ph., 60 cy. generator with Curtis single stage 160/125 pound non-condensing turbine good for 5 to 10 pounds back pressure
1—500 KW, G.E., 625 KVA, 2300 v., 3 ph., 60 cy. generator with Curtis 4 stage, 150 pound condensing turbine complete with condenser, etc.

ROTARY CONVERTERS

60 Cycle

2—1500 KW, Whse. 720 RPM 650 v. DC with 3-single phase, 33000 v. transformers and panel
1—1500 KW Whse 720 RPM 600 v. DC with 1- three phase 11500 v. transformers and panels
2—1000 KW whse. 900 RPM 650 v. DC with 3- single phase 11800 v. transformers and panels.
2—1000 KW, G.E. HCC 900 RPM 600 v. DC with 1-three phase, 11000 v. transformer and panels
1—750 KW Whse 720 RPM 250 v. DC with three phase 6600/2300 v. transformer and panels.
1—500 KW, Westinghouse, 900 RPM, 125/250 volt, DC, with 3- single phase, 60 cycle, 13200/6600/2300 volt transformers and panels
1—300 KW, G.E., type HCC, 1200 RPM., D.C., 600, V, AC, 6 ph., 1200 RPM.

A C MOTORS

3 phase—60 cycle

Synchronous

	HP	Make	Type	Volts	Speed
1—	500	G.E.	TS	440	360
1—	350	Cr.Wh.	301	2200	600
1—	300	G.E.	ATI	440	600
1—	300	G.E.	ATI	2300	600
1—	250	G.E.	ATI	220	450
1—	200	Whse.		440	514
3—	150	G.E.	TRB	220x440	450
1—	150	Whse.		2200/550	1800
1—	100	Whse.		2200/550	1800
1—	100	Whse.	HP	220	300
1—	100	Whse.	G	2300	900

Slip Ring

1—	1000	G.E.	IM	2200	720
1—	800	Whse.	CW	440/2300	440
1—	600	G.E.	IM	2200	900
1—	600	Al.Ch.	ANY	2200	1180
1—	450	Whse.	CW	2200	875
1—	400	G.E.	MT	550/440	300
1—	400	Al.Ch.		2300	505
1—	300	G.E.	IM	2300	585
1—	250	G.E.	MT-410	2300	400
1—	250	Whse.	CW	440	585
1—	250	G.E.	MT	4000/2300	257
2—	200	Whse.	CW	2200	514
1—	200	G.E.	IM	440	435
2—	175	G.E.	IE-15A	2200	880
1—	150	G.E.	IM	2200	695

Squirrel Cage

1—	500	G.E.	1-17B	2200	690
1—	400	G.E.	KT	2300	585
1—	300	Whse.	CS	550	880
2—	300	G.E.	IK	2300	600
1—	300	Al.Ch.		2200	1160
1—	250	Al.Ch.		220/440	1150
1—	200	Whse.	CS	440	580
1—	200	Whse.	CS	550	720
1—	200	Al.Ch.		2200	1750
1—	150	G.E.	IK	2200/440	900
3—	150	Al.Ch.	AN	220/440	1750

RE-NU-BILT BELYEA MOTORS

What are your requirements? units up to 5000 kw available in stock.

BELYEA COMPANY INC.

Main Office & Shop: 43 HOWELL ST., JERSEY CITY, N. J.

POWER PLANT MACHINERY

Available Immediate Delivery

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

3750 KVA G.E. condensing 200 lb. pressure, 100° superheat, 2300 volts, 1800 RPM, complete with surface condenser.

2500 KVA ALLIS condensing 150-200 lb. pressure, 100° superheat, 480 volts, 3600 RPM, complete with condenser and auxiliaries, switchboard panel and instruments.

1563 KVA G.E. condensing 175-200 lb. pressure, 500° T.T., 2300 volts, 3600 RPM, complete with surface condenser and condensing auxiliaries.

1250 KVA ALLIS condensing 150-200 lb. pressure, 100° superheat, 2300 volts, 3600 RPM, complete with Wheeler surface condenser.

937 KVA G.E. condensing 200 lb. pressure, 100° SH, 2300 volts, 3600 RPM complete with Ingersoll-Rand condenser, exciter, switchboard and instruments.

937 KVA (2) WESTINGHOUSE automatic extraction condensing, 150 to 200 lb. pressure, 10 lb. gauge back pressure, 480 volts, 3600 RPM, complete condensers, exciters, switchboards and instruments.

937 KVA ALLIS condensing 200 lb. pressure, 100° SH, 2300-550-480 volts, 3600 RPM complete surface condenser with auxiliaries, direct connected exciter—Modern and practically new.

937 KVA WESTINGHOUSE non-condensing, 175-200 lb. pressure, 10 lb. back pressure, 480 volts, 3600 RPM, complete motor driven exciter set, switchboard and instruments.

937 KVA ALLIS condensing 150 to 200 lb. pressure, 475° TT, 2300 volts, 3600 RPM, complete with direct connected exciter, surface condenser and auxiliaries.

750 KVA G.E. condensing, 150-200 lb. pressure, 2300 volts, 3600 RPM, complete surface condenser and exciter set.

375 KVA G.E. condensing 225 lb. pressure, 150° S.H., 2300 volts, 3600 RPM, complete direct connected exciter, Manistee jet condenser with auxiliaries.

112 KVA TERRY-ALLIS CHALMERS non-condensing 175-200 lb. pressure, 0-8 lb. back pressure, 480 volts, 3600 RPM, complete direct connected exciter, switchboard and instruments.

MOTOR GENERATOR SETS

1500 KW ALLIS 600 volt direct current generator direct connected to a 2190 HP, 3 phase, 60 cycle, 4000 volt, 300 RPM synchronous motor.

750 KW G.E. 550 or 275 volt, direct current generator direct connected 1075 HP 90% P.F., 3 phase, 60 cycle, 4000 volt, 514 RPM synchronous motor.

75 KW, General Electric, 125 volt, direct current generator direct connected to a 112 HP, 3 phase, 60 cycle, 440 volt, 1200 RPM Electric Machinery Company synchronous motor, complete with switchboard and instruments.

20 KW G.E. 125 volts direct current generator direct connected 25 HP, 3 phase, 60 cycle, 220 volts, 1200 RPM motor.

ENGINE-GENERATOR UNITS

3 phase, 60 cycle—Alternating Current

1125 KVA G.E. 480 volts, 150 RPM direct connected 24"x46"x33" Erie-Ball cross compound engine, complete exciter, and rheostats.

1000 KVA G.E. 480 volts, 150 RPM direct connected 31"x36" Skinner Unaflow engine, complete exciter, switchboard panel and instruments.

500 KVA G.E., 240/480 volts, 150 RPM direct connected 26"x32" Skinner Universal Unaflow non-condensing engine, 130-160 lb., 6 lb. back pressure, complete exciter and rheostats.

500 KVA G.E. 240 volts, 120 RPM direct connected 20"x42" Rice Sargent Corliss non-condensing engine, 125-150 lb., 10 lb. back pressure.

438 KVA G.E. 240/480 volts, 150 RPM direct connected 24"x30" Chuse N.R.C. non-condensing engine, 125-150 lb. pressure, 5 lb. back pressure.

ENGINE-GENERATOR UNITS

Direct Current

1500 KW WESTINGHOUSE 250 volts, 360 RPM generator direct connected by reduction gear to a Westinghouse condensing turbo generator unit complete with auxiliaries.

500 KW G.E. 250 volts, 150 RPM direct connected 26"x36" Skinner Universal Unaflow non-condensing engine.

300 KW WESTINGHOUSE 250 volts, 175 RPM direct connected 24"x26" Skinner Unaflow non-condensing engine, 110-150 lb. pressure, 5 lb. back pressure, complete switchboard and instruments.

250 KW (2) CROCKER-WHEELER, 1000 amperes, 250 volts, 180 RPM direct connected each to 20"x24" Skinner Universal Unaflow non-condensing engine, 150-200 lb. pressure, 0-10 lb. gauge back pressure with switchboard panels and instruments. These are duplicate sets—a complete installation.

200 KW G.E., 125 volt, 200 RPM direct connected 18"x24" Erie Ball non-condensing engine, 135-150 lb. pressure.

100 KW GENERAL ELECTRIC, 125 volts, 250 RPM direct connected Skinner Universal Unaflow non-condensing engine, complete switchboard and instruments.

MOTORS

3 phase, 60 cycle

800 HP, WESTGH. 440 V., 240 RPM synchronous.

620 HP G.E. type ATI, form S, 440 volt, 164 RPM synchronous.

400 HP, G.E. type TS, Form AL, 440 V. 300 RPM synchronous.

400 HP, WESTINGHOUSE type CW, 440 V., 500 RPM, slip ring.

300 HP, 80% P.F. WESTINGHOUSE 2300 V., 200 RPM synchronous.

250 HP, ALLIS-CHALMERS 440 V., 600 RPM synchronous.

200 HP G.E. 2200 volt, 435 RPM slip ring.

125 HP, (3) 80% P.F. Elec. Mchy. 440 V., 400 RPM synchronous with starting equipment.

125 HP, 80% P.F. Elec. Mchy. 440 V., 514 RPM synchronous.

50 HP, type I, form M, 3 phase, 60 cycle, 2200 volts, 1200 RPM slip ring.

50 HP, (2) G.E. form K, 220 V., 900 RPM squirrel cage.

MISCELLANEOUS

1 WESTINGHOUSE frequency changer set consisting of a 655 HP, 3 phase, 25 cycle, 2200 volt, 300 RPM synchronous motor direct connected to 565 KVA 80% P.F., 3 phase, 60 cycle, 240 volt alternating current generator complete and equipped with direct connected exciters, all panels with instruments—practically new.

250 KW CROCKER-WHEELER 250 volt, 600 RPM compound wound interpole direct current generator.

1500 KVA, 3 phase, 60 cycle, 22,000 volt primary, 2300 volt secondary WESTINGHOUSE transformer.

900 KW G.E. 3 phase, 60 cycle, 480 volt, 150 RPM alternating current generator with exciter.

500 KVA IDEAL, 3 phase, 60 cycle, 240 volts, 400 RPM, three-bearing belted type generator with direct connected exciter and rheostats.

312 KVA WESTINGHOUSE, 3 phase, 60 cycle, 2300 or 220 volts, 200 RPM, engine type generator with belt driven exciter and rheostats.

200 KVA WESTINGHOUSE, 3 phase, 60 cycle, 240 volts, 200 RPM engine type generator with rheostat.

1 ELLIOTT EHRHART jet condenser with all auxiliaries suitable for operation with a 5000 KW turbine-generator unit.

1500 sq. ft. WESTINGHOUSE surface condenser.

1055 cubic feet, 100 lb. air pressure CHICAGO PNEUMATIC horizontal compressor direct connected to 170 HP, 240 V., 150 RPM General Electric direct current motor.

SPECIAL

800 KVA (2) G.E. 3 phase, 60 cycle, 2300 volt alternating current generators each direct connected to a 1250 HP Nordberg vertical full Diesel engine complete with all auxiliaries—exact duplicates.

Utilities Electrical Machinery Corporation
600 NATIONAL CITY BANK BLDG.
CLEVELAND, OHIO
WIRE OR PHONE
LONG DISTANCE 422

Dependability Assured With Chicago Electric Rebuilding

MOTOR-GENERATOR SETS

500 KW GE 600 DC syn 4400/2200
300 KW GE 3-unit syn 2200 AC
300 KW GE 600 DC syn 11000/2200
225 KW Idl 115 DC syn 2200 AC
225 KW Wtg 115 DC syn 2200 AC
150 KW GE 250 DC syn 2200/220
100 KW Wtg 275 DC syn 2200 AC
100 KW AC 115 DC syn 440 AC
100 KW Wtg 3-w DC ind 440 AC
100 KW Wtg 125 DC ind 2200 AC
100 KW Wtg 125 DC syn 2200 AC
100 KW GE 250 DC ind 2200 AC
100 KW GE 250 v DC in. 220/440 AC
75 KW GE 125 DC syn 220 AC
90 HP Wtg 110 DC gen 2200 AC
75 KW GE 125 DC ind 440 AC
2—50 KW Wtg 3-w DC ind 440 AC

BOILER FEED PUMP

Worthington size 12"x7½"x15" 300# water press. 175# steam press. duplex plunger type.

FEED WATER HEATER

5000 HP Hoppes 10# per sq.in.

ROTARY CONV.

200 KW Gen. Elec. 250/275 volts DC 6 phase, 440 volts AC, all switchgear and transformer equipment.

SLIPRING

HP	Make	Type	Volts	Speed
600	GE (2)	IM	2200	1770
500	GE (3)	IM	2200	600
350	GE	MT	2200	300
350	Al. Ch.		2200	300
300	GE	MT	2200	514
250	GE	IM	2200	1175
200	GE (2)	IL	440	600
225	GE	IM	440	600
200	Howell rl. brg.		440	600
200	GE	IM	2250	600
200	Wtg.	CW	440	580
200	Wtg.	CW	440	345
150	Wagner	BR	440	1150
150	Al. Ch.	ANY	440	870
150	Wtg.	CW	440	600
150	GE	IM	220	600
150	GE	IM	220	585
150	Wtg.	HF	440	230
125	GE	MT	440	720
75	Al. Ch.		225	720
75	GE	MT	440	850

Have large stock smaller sizes.

SQUIRREL CAGE

HP	Make	Type	Volts	Speed
200	GE	IK	440	580
200	Wtg.	CS	440	580
150	GE	IK	2200	1750
150	Wtg	CS	2200	1175
150	A.C.		440	1170
125	GE	KT	220	1800
125	GE	IK	2200	580
100	Wtg (2)	CS	440	1160
100	Wtg	CS	2200	1160
100	GE	IK	220	1200
100	GE	IK	440	900
75	GE	IK	2200	1760
60	Al. Ch.	AR	440	3500
60	Wagner	VRX	220	1200
60	GE	IK	220	900
60	Wtg	CS	220	435
50	Howell	FBB	220	1725
50	Watson	KH	440	1720
50	GE (2)	KT	2200	870
50	GE	IK	440	490

Have large stock smaller sizes

ENGINES

800 KW GE type ATB 3/60/480 v ac gen. no back press. 150 RPM with chain driven exciter, dir.-conn. Skinner universal unaflow engine. 500 KW GE MPC 250 volts interpole with Skinner uniflow engine, 500 HP Winton 8-cylinder gas engine, 1100 RPM overhead valve type can furnish with AC gen.

FREQUENCY CHANGERS

90 KW GE adj. consisting of a 60 HP 3/60/220 v 4-speed motor with motor starting compensator and pole changing switch, motor direct-coupled to a 3 ph. freq. changer rated 90 KW 60/120 cy. 75 KW 60/100 cy. 68 KW 60/90 cy. 60 KW 60/80 cy.

500 KVA Westinghouse with 583 HP 3/25/2300/575/440/220 v. 750 RPM syn. motor, driving 500 KVA 3/62½ cy. 2300/460/220 v. syn. gen. both machines amortisseur equipped, can be operated from 60 cy. to furnish 24 cy.

Special Sq. Cage

10 all alike, 75 HP GE type I form K, 3/60/420 v. 600 RPM with CR1034 compensators.

Pump

825 GPM 325 ft. head. American Well Works, with 100 HP Wtg CS1160 RPM 3/60/4000/2200 volts ind. motor.

Variable Speed DC 230v.

HP	Make	Type	Speed
50	Burke	Am20	400/800
40	Chandeys.	F16	950/1150
35	J & L.	EI	560/860
35	Cr. Wh.	CM	375/900
25	Allis Ch.		235/1000
25	Allis Chal.		350/1050
25	Westing.	SK150	300/900
25	Westg.	S9	560/780
15	GE	RLC	500/1000
15	Burke	AM	550/1650
15	Reliance	131T	600/1200
12½	Westg.	SK70	750/1500
10	Westg.	SK80L	500/1500
10	Reliance	92 (2)	600/1200
10	Gen. Elec.	C	825/1500
10	Gen. Elec.	LC	1000/1500

1—25/50/100 HP wtg. SK175/350/700 RPM.

Synchronous Condensers

3 phase, 60 cycle

HP	Make	Type	Volts	Speed
1000	Wtg		440	900
2000	GE	ATI	11000	1200

Let us have your Power Plant and Electrical inquiries as we have a large and varied stock, or can find the unit you need.

Chicago Electric Co.

Write for FREE Stock Catalog . . . Just Off The Press!

PHONE CAN. 2900 — 1320 WEST 22ND. STREET ★ CHICAGO, ILLINOIS

MOTORS • GENERATORS • TRANSFORMERS

Prices on Application

3 PHASE—60 CYCLE 220/400 VOLT

H.P.	Make	RPM	Type	Frame
15	Allis-Chalm.	1750	2K54411	
20	Gen. Elec.	1750	KT	753
20	Gen. Elec.	600	I	K
25	Burke	900	EM	
40	Gen. Elec.	900	KT	336
40	Burke	1200	EM	45
40	Westing.	1750	CS	
50	Westing.	900	CS	
50	Gen. Elec.	900	KT	542
60	Burke	900	EM	7
60	Gen. Elec.	1200	I	K
60	Gen. Elec.	1800	I	K
75	Gen. Elec.	1200	KT	343
5) 75	Gen. Elec.	1200	I	K
75	Gen. Elec.	1800	I	K
75	Gen. Elec.	900	I	K
100	Burke	720	EM	10
100	Gen. Elec.	1750	I	K
100	Westing.	900	CS	
100	Lincoln	1200		
150	Gen. Elec.	1200	I	
150	Westing.	900	CS	
200	Gen. Elec.	600	I	K
200	Gen. Elec.	720	I	K
200	Gen. Elec.	900	I	K
200	Gen. Elec.	1200	I	K
250	Gen. Elec.	600	I	K
250	Gen. Elec.	720	I	K
250	Allis-Chalm.	900		
300	Gen. Elec.	720	I	K

Compressors in stock up to 300 H.P.

AIR COMPRESSORS

1—14"x9"x12" Imperial-Type Ingersoll-Rand two stage 100 lb. pressure belt drive.

1—16"x10"x14" Imperial-Type Ingersoll-Rand two stage 100 lb. pressure belt drive.

BARGAIN
30—3 HP. General Electric Motors. 3/60/220/3600 rpm. $37.00 each.

100 K.V.A. GENERATOR For Diesel Use
1—100 KVA Crocker Wheeler 3/220/60 cy. 257 RPM. For Direct connection to Diesel. 2 Bearing Machine with exciter and panels.

ANODIZING M. G. SET
1—1000 Amp. 60 Volt General Electric Generator, Type CD-115Y, 1200 RPM, direct connected to 90 H.P. General Electric Synchronous Motor, 3 phase, 60 cycle, 440 volt, 1200 RPM; 3-bearing Factory built machine, complete.

SPECIAL MOTORS

1100 H.P. General Electric Synchronous Motor, 3 ph., 25 cy., 11,500/6600/2200 V., 375 RPM.
1—500 H.P. Gen. Elect. Sync. 3/2200/60/1200 R.P.M. with Exciter. New.
500 H.P. Allis-Chalmers, 3 ph., 25 cy., 440 V., 490 R.P.M., Complete.
300 H.P. G.E. Slipring, 25 cy., 3 ph., 2200 V., 500 RPM, 3 bearing; complete with controls.
225 H.P. Electric Mchy. Co. Synchronous, 3 ph., 25 cy., 2200 V., 500 R.P.M. with controls.
2—100 H.P. G.E. Synch. Motors, 3 ph., 25 cy., 220/440 V., with control equipment.

FREQUENCY CHANGERS

1—600 KW Gen. Elec. Syn. 2300 V., 25 cy. to 2300 V. 60 cy.
1—565 KVA Westinghouse Synch. 2200 V. 25 cy. to 220 V. 3 Ph. 60 cy.
2—400 KW General Electric Synch. 6600 V., 25 cycle to 440/2300 V. 60 cy.

TRANSFORMERS

Amt.	KVA	Make	Cycle	Voltage
3	40	Gen. Elec.	25	2200/440
3	50	Gen. Elec.	60	2200/220/440
2	75	West.	60	2200/120/240
3	100	Gen. Elec.	60	24/120/240
2	100	Gen. Elec.	60	4600/115/230
3	200	Gen. Elec.	25	13,200/240/480
3	333	Gen. Elec.	60	6900/230/460
3	500	Gen. Elec.	60	2200/220/440
3	500	Pittsburgh	25	11,500/100
3	833	Gen. Elec.	60	13,800/460
3	1000	Pittsburgh	60	2300/4600/115
3	1000	KVA.Wagner	60	33000/2300

All sizes and Voltages Available.

SLIPRING MOTORS

60 CYCLE, 3 PHASE, 220/440 VOLTS

H.P.	Make	Type	Frame	RPM
300	Gen. Elec.	I	Form M	1185
75	Gen. Elec.	MT	537	1800
60	Gen. Elec.	MT	353	1800
60	Gen. Elec.(2)	MT	353	720
50	West.	CW	654C	1800
50	West.	CW	644C	900
50	West.	CW	654C	1800
40	Wagner	22WB		540
40	West.	CW	748	690
40	West.	CW	748	690
40	West.	CW	748	690
30	West.	HF	8B	1745
30	Gen. Elec.	MTC		1725
25	Gen. Elec.	MT	513	1800
25	Gen. Elec.	I	M	1200
25	West.	CW	750C	575
20	West.	CW	648A	575
20	West.	CW	644C	575
20	Gen. Elec.	MT	332	545
20	West.	CW	748A	575
20	West.	CW	748A	575
20	West	CW	748A	575
15	Gen. Elec.	I-M		1725
15	Gen. Elec.	ITC		1725
10	Gen. Elec.	MT		1725

25 CYCLE, 3 PHASE, 440 VOLTS

H.P.	Make	Type	Serial	RPM
150	Gen. Elec.	MT563Y	5056230	725
125	Gen. Elec.	I-17	4550934	360
50	Gen. Elec.	MT547	5264084	720
50	Gen. Elec.	MT353	3879210	750
50	Allis-Chal.		7923K	715
52	Gen. Elec.	ITC5013	1773223	700
40	Gen. Elec.	MT543	4817983	750
40	Gen. Elec.	MT343	3887755	750

GENERATOR & EXCITER

1—62½ KVA 3 ph. 60 cy. 240 v. 1200 rpm Allis-Chalmers generator, serial No. 113797, with exciter, direct Connected stock No. E11317. Comp. with Base Pulley and Panel.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. — BUFFALO, N. Y. — CL. 4758

TURBOS 60 cy

1—4000 KW GE 7-stage double bucketed 60/3/6600/1800 RPM 150/200# ISP. Surface Condenser, exciter and pasels.

1—3125 KVA Lynn Type GE Rigid Frame 4-stage 60/3/2300/3600 RPM. Surface Condenser equipped. Unique minimum log service.

1—2500 KVA Wemco Imp & Reac 60 3/2300/3600 RPM, Surface Condenser. Rare short log service.

1—1000 KW 80% PF GE Curtis Form B 60/3/4800 Y connected /3600 RPM. Turbo 4-stage 225# 200° Superheat condition. Has recently operated NC at full load 15# Gauge. Self-contained exciter, no condenser available. Unit reported like new.

1—625 KVA Wemco 10-C Parsons or NC 60/3/440/2200/3600—Jet Condenser—Surface available.

1—300 KW Wemco Single Wheel Re-entry 6-/3/240-120/250#.

TURBOS 25 cy

6250 KW 80% PF Parsons design Multiple Expansion Parallel Flow 25/3/4000/1500 RPM, Surface Condenser equipped.

6000 KW GE Curtis 25/3/6600/1500 RPM, Jet Condenser equipped.

2—7200 KVA Wemco Impulse and Reaction Semi-Double Flow 25/3/11000/1500 RPM. Surface Condenser equipped.

3—4000 KW 80% old rated (log service record 7500 KW) Wemco Impulse anl Reaction design 25/3/13200/1500 RPM. Surface Condenser equipped.

2—3500 KW Wemco 25/3/13200/1500 RPM with combined 18000 sq. ft. Surface Condenser.

2—2000 KW Wemco Parsons Multiple Expansion Parallel Flow 25/2/6600/1500 RPM.

TURBOS DC

1—500 KW GE Mixed Pressure 16 to 140# 250 volts DC. Surface Condenser 3100 sq. ft.

MOTOR GENERATORS

1—1500 KW GE MPC 60/3/4000 to: 600 volts DC.

BOILERS

2/1000 HP Edgemoor ASME identified 200# Box Steel Header Straight Tube Water Tube Boilers, oil-fired, practically brand new, one never operated; one operated few months only on experimental program.

3—833 HP B&W Stirling ASME Boilers 200#. Wemco Underfeed Stokers.

9—600 HP B&W Vertical Steel Header Longitudinal 3-drum 200# Superheater and Taylor Stokers.

6—600 HP Stirling 4-drum 200# pressure chain grate Stokers.

2—525 HP Springfield Cross Drum Sectional Header ASME Water Tube Boilers 225#. Superheaters and Chain Grates.

3—500 HP Egdemoor Steel Header Boilers—200#—Foster Superheaters.

3—500 HP B&W Stirling 200# ISP superheaters.

2—484 HP Springfield Horiz. ASME Straight Tube Longitudinal Cross Drum Boilers, one 200#, the other 225# and with Wemco Stoker.

1—400 HP B&W Stirling 200# no superheater.

1—389 HP B&W Stirling Water Tube ASME and Hartford—200#. Stokers and all auxiliaries.

POWER PLANT EQUIPMENT CO., INC.

39 Cortlandt Street
New York, N. Y.

AC TURBINE UNITS

1250 KVA G. E. 2300/4000 v., 600° TT.; Cond.
937 KVA G. E. 2300-600 V.; *Non-Con.*
937 KVA Al. Chal. 2300 v., 550° TT.; Cond.
937 KVA G. E. 2300 V., 500° TT.; Cond.
937 KVA Al. Chal.-Elliot 480 V., 500° TT. Cond.
937 KVA G. E. 2300 V. Automatic Extraction, 500° TT.; Cond.
780 KVA Al. Chal.-Terry 600 V., Automatic Extraction, 500° TT.; Cond.
780 KVA Wghse. 2400 V., 500° TT.; Cond.
625 KVA G. E. 2300 V., 500° TT.; Cond.
625 KVA Al. Chal.-Elliot 440/220 V., Automatic Extraction, 500° TT.
625 KVA Wghse. 2300 V., 500° TT., *Non-Cond.*
375 KVA G. E. 2300 V., 500° TT.; with Cond.
375 KVA G. E. 2300 V., 500° TT.; *Non-Cond.*
312 KVA Ridgeway-Elliot, 480 V., 500° TT. Cond.
150 KVA Wghse. 240/480 V., 500° TT.; Cond.

DIRECT CURRENT UNITS

KW	GEN.	VOLTS	ENGINE
1000	Al. Chal.	250	Al. Chal.
600	G. E.	250	Corliss
500	C. W.	250	Hamilton Unif.
300	G. E.	250	Skinner Unif.
300	Wghse.	250	Murray Corliss
200	Wghse.	250	Turbine
200	G. E.	250	Skinner Unif.
200	G. E.	125	Erie Ball 4 V.
100	C. W.	250	Erie Ball 4 V.
100	G. E.	125	Erie Ball 4V.

A.C. UNITS

450 KVA Wghse.—18x36 Filer Stowell Corliss
375 KVA G.E.—22x27 Erie Ball 4 V.
312 KVA G.E.—20x30 Fitchburg 4 V.
312 KVA Elec. Machy—20x24 Chuse Uniflow
312 KVA Wghse.—21x22 Skinner Uniflow
300 KVA G.E.—18x36 Murray Corliss
300 KVA G.E.—Murray Uniflow
250 KVA G.E.—18x42 Hewes-Phillips Corliss
250 KVA G.E.—17x20 Erie Ball, 4 V.
200 KVA G.E.—21x22 Skinner Uniflow
200 KVA Al. Chal.—14x36 Al. Chal. Corliss
125 KVA G.E.—14x15 Skinner Uniflow
112 KVA G.E.—14x18 Erie Ball 4 V.
100 KVA G.E.—14x16 Skinner Uniflow
60 KVA G.E.—12x12 Skinner Uniflow

BOILERS (ASME)

728 HP E.C. Vert. 200#
685 HP Sterling 200#; Harrington Chain Grate Stokers
500 HP Murray (Heine) 200#
484 HP Springfield Cross drum, 200#
471 HP Erie City vert, 200#
420 Sterling, 200#
407 HP (2) Erie City bent tube, 250# "National Board"
389 HP Sterling 200#. "National Board".
340 HP (2) Brunswick Kroeschell, cross drum, box header. 165# "National Board."
320 HP Sterling, 200# With Detroit Underfeed stokers.
300 HP (2) B & W 160#
300 HP Heine 175#
295 HP (3) Sterling, 200#
253 HP Cumbustion Engr. Co. 165#. "National Board"; practically new with Detroit Roto-stoker

ROTARYS

1500 KW Wghse. 600 V.—3 ph., 60 cy.
1000 KW G.E. 600 V.—3 ph., 60 cy.
500 KW G.E. 600 V.—3 ph., 60 cy.
400 KW (2) G.E. 250 V.—3 ph., 60 cy.
300 KW G.E. 600 V.—3 ph., 60 cy.
100 KW G.E. 275 V.—3 ph., 60 cy.

FREQUENCY CHANGERS

625 KVA Wghse. 60—25 cycles
625 KVA G.E. 25—60 cycles

TRANSFORMERS

2—687 KVA Maloney 2200/220 V.
2—500 KVA Maloney 13,800/480 V.
3—100 KVA Al. Chal. 22,000/440 V.
3— 75 KVA Wghse. 2300/575 V.

COMPRESSORS

1300 CFM Ingersoll-Rand 100 lbs, with 200 HP G.E., 3-60-440 V. motor
1200 CFM Worthington 100#—motor
1000 CFM Ingersoll Rand 100#—with 100 HP A.C. motor
250 CFM Penn. 150#—motor

SURFACE CONDENSORS

2000 Sq. Ft. Wheeler
1200 Sq. Ft. Worthington

HEATERS

All sizes and types

ENGINES (belted)

TWIN ENGINE: 22x36 Nordberg Uniflow
20x21 Skinner Uniflow (15-20 lbs. b.p.)
16x16 Ames Uniflow

GAS & DIESEL UNITS

1000 KVA G.E. 3 ph., 60 cy., with Cooper Bessemer nat. gas engine
375 KVA Wghse. 3 ph. 60 cy.—Busch Sulzer
250 KVA F.M. 3 ph. 60 cy.—Style VA.
200 KVA G.E. 3 ph., 60 cy., Busch Sulzer Diesel
168 KVA Ideal 3 ph., 60 cy., with Fulton 3 cyl. Diesel Engine; dir. con. exciter
OIL HEATING & PUMPING UNIT; suitable for 1000 HP to 5000 HP in boilers

Let MacCABE lift your Worries!

Electrical Equipment For The Iron & Steel Plants & Allied Heavy Industries.

CRANE & MILL MOTORS
(230-VDC. SERIES & COMPOUND)

H.P.	MAKE	TYPE
2—1	P & H	Size 5¼ x 3½
3—6	G.E.	C.O. 1805
2—7½	Westgshe	MT-000 (Back Axle)
1—8	Shaw	Type "Z"
2—9½	G.E.	MDP-#404-A
2—10	P & H	Size 9 x 5½
6—15-20	G.E.	C.O. 1807
1—19	G.E.	M.D.-#406-AE
1—19	C.W.	B.W. (Back Axle)
2—19	C.W.	Type B.W.
2—25	G.E.	Type #52
3—32	Shaw	Type "Z"
1—50	G.E.	C.O. 1829
3—50	G.E.	C.O. 1810
2—65	G.E.	C.O. 1811
1—65-85	G.E.	C.O. 1830
1—60	Westgshe	K-10
1—60-80	G.E.	MD-106 (Back Axle)
5—55-65	Westgshe	MCA-#20
4—50	Shaw	Type "Z"
1—100	G.E.	C.O. 1812
1—150	Westgshe	MCB-100(Back Axle)

OTHER 230-VDC. MOTORS

1—5	Westgshe	1150/1650	SK-33
1—7½	Westgshe	Comp.	SK-60
1—7½	Westgshe	400/1600	SK-103

1—70 (New) Reliance 600/1200 Frame 461-T (with new EC&M Automatic Panel with this Motor).

CAN YOUR OVERHEAD CRANES STAND THE GAFF?

We specialize in rebuilding overhead electric traveling cranes, monorail electric hoists, foundry & steel plant equipment and would appreciate your inquiries for this type of equipment.

AUTOMATIC CONTROL PANELS (230-VDC)

1—EC&M. (New)
4—EC&M 55-HP. Dynamic Lowering.
2—EC&M 64-HP. Dynamic Braking for (2)–32-HP. motors.
2—EC&M 100-HP. Dynamic Braking for (2)–50-HP. motors.
4—EC&M 110-HP. Dynamic Braking for (2)–55-HP. motors.

WE HAVE IN STOCK (150) 230-V. DC. CONTROLLERS SERIES & DYNAMIC LOWERING G.E. WESTGSHE C.H. DRUM TYPE & EC&M. DINKY TYPE, 5 to 100-HP. (30)—10 to 50-HP. C.H., EC&M, Clark & Westgshe Elec. Brakes.

CRANE MOTORS
(220-440-V. 3-PH. 60-CY.)

H.P.	MAKE	TYPE
1—2-9	G.E.	KT-927
1—5	G.E.	MTC-5201 (25-CY.)
1—15	E.DY.	#1601 Bal. (2-phase)
1—22	G.E.	I.T.C. 5010
1—25	Westgshe	CI-(2-phase)
1—25	G.E.	MQC-5526
1—30	G.E.	ITC-5011
1—30	Westgshe	C.I.
2—35	Westgshe	C.I. (2-phase)
2—37	G.E.	ITC-5011
2—37	G.E.	ITC-5011 (2-phase)

The largest Plant in the County Specializing in Rebuilding this Type of Equipment. "All This Equipment in Stock—Immediate Shipment"

T. B. MacCABE COMPANY

4306 CLARISSA STREET · PHILADELPHIA, PA.

BETTER USED EQUIPMENT

for Immediate Delivery—at Low Prices

CONVERTERS

7—**DUPLEX ROTARY CONVERTERS,** G. E., (Identical) 1500 KW—750 KW, 500 RPM, 13,200 V., 3 phase, 25 cycle, to 1300—650 volt direct current. Complete with Transformers, Reactances, Switch Gear and Controls.

Motors - Sheet Steel Piling - Hoists Cranes - Misc. Items

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DULIEN STEEL PRODUCTS, Inc.
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SEATTLE • PORTLAND • SAN FRANCISCO

Motor Generator Sets—Synchronous Motors, etc.

MOTOR GENERATOR SETS,
3 phase, 60 cycle, A.C.
250 KW G.E. Rotary 275 Volt D.C. 2300 Volt A.C.
100 KW West. Rotary 275 Volt D.C. 2300 Volt A.C.
75 KW West. M.G. Set 250 V. D.C. 440 V. A.C.
50 KW Allis-Chalmers 250 V. D.C. 2200 V. A.C.

SYNCHRONOUS MOTORS
3 phase, 60 cycle
2—G.E. 700 HP 720 RPM 6600/4000/2300 Volt
Burke 300 HP 900 RPM 440/220 Volt
Ridgway 150 HP 1200 RPM 2300/440 Volt
C.W. 100 HP 900 RPM 440/220 Volt
Fairbanks-Morse 75 HP 720 RPM 220 Volt
G.E. 60 HP 720 RPM 440/220 Volt

SLIP RING MOTORS 3 phase 60 cycle
West. 150 HP 720 RPM 550 Volt
G.E. 60 HP 720 RPM 440/220 Volt
Allis-Chalm. 250 HP 600 RPM 440/220 Volt

ADJUSTABLE SPEED
220 Volt D.C. Motors
1—G.E. RF-18 90/120 HP 400/1200 RPM
1—G.E. RF-17 50/100 HP 450/1200 RPM
1—Reliance 1400-T 100/125 HP 300/900 RPM
1—West. SK-180, 100 HP 600/950 RPM
1—West. SK-180 45/90 HP 475/950 RPM
1—Diehl 50 HP 400/1200 RPM
1—Reliance 1400-T 50 HP 175/700 RPM
2—Crocker-Wheeler 125-H 50 HP 175/700 RPM
1—West. SK-143 40 HP 500/1500 RPM
1—Reliance 461-T 40 HP 475/1500 RPM
1—Allis-Chalm. 35/70 HP 450/1350 RPM
1—Allis-Chalm. 25 HP 600/1800 RPM
2—West. SK-123 5 HP 300/1200 RPM enclosed

The Electric Motor & Repair Co., Cuyahoga Falls, O.

100 HP MOTOR

Rebuilt—General Electric, type MT, Motor, 900 RPM, 440 volt, 3 phase, 60 cycle, serial No. 4259356, with drum type control, resistance grids, rail and pulley.

DENNY & CLARK
910 No. Marshfield Ave. Chicago. Ill.

ELECTRIC DRIVEN ICE MACHINES

Direct connected to Synchronous Motors and belted to 3 bearing Slip Ring Motors 125 to 225 H.P. 3/60/220 G.E. & West'h.

ROBT. W. LYSLE & CO.
UTILITIES BLDG. CHICAGO
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FOR SALE!

2—100 K.W. engine D.C. Gen. 220 V.
2— 75 K.W. engine D.C. Gen. 220 V.
1—150 K.W. A.C. Gen. 230 Volts all 4 valve.

WANTED!
1—300 K.W. 4 valve engine A.C. Gen. 3 P.

JOHN McARTHUR
204 N. Jefferson St. CHICAGO, ILL.

ALWAYS TRY US WHETHER BUYING OR SELLING

1000 KW **Allis Chalmers Turbo Generator.** 1800 rpm, 3-60-440 V. Condensing with 3200 ft. Surface Condenser. Also suitable non cond.
5000 HP **Hoppes Feedwater Heater.**
300 KW 250 V. direct current **Diesel Generator.**
25 ton **Ohio Steam Locomotive Crane.**
75 and 125 HP **Firebox Steam Boilers.**
30 ton Standard Gauge **Gasoline Locomotive.**
10 to 40 ton **Steel Derricks,** 70 to 120' boom

Mississippi Valley Equipment Co.
507 Locust St. St. Louis, Mo.
"What do you Need or Have to Sell?"

FOR SALE

4 — 150 KVA Pittsburgh **Transformers** 2400/240 V.
3 — 15 KVA **Transformers** 2400/120/240 V.
2 — General Electric 400 amp., 7500 V., 3 pole oil **Switches.**

Can be inspected at the plant of the
Eastern Corrugated Container Co.
205 Clifton Blvd.
(Old Cretona Building) Clifton, N. J.

250 HP **Erie City** Water Tube Boiler, 180#.
2—500 HP **Heine** V Water Tube Boilers, 160#.
75 HP **Buda** 6 cylinder Diesel, Elec. starter.
100 HP **Fairbanks** Y-V with clutch, complete.
100 HP **Superior** Nat Gas Engine with clutch.
400 HP **Sterling** Nat Gas Generator Set 480V.
Let us have your Inquiries and Offerings.

MID-CONTINENT EQUIPMENT CO.
710 Eastgate Pa 2290 St. Louis, Mo.

FOR SALE—INLET AND EXHAUST VALVES

100—Diesel poppet valves, blue-print series H-4202 for Superior engines, 6 x 8 to 6 x 12
50—Diesel poppet valves, blue print series H-6054 for Superior engines, 8 x 10 to 8 x 14
Made as original equipment, never used. Will sell all or part at sacrifice price.

JOHN S. SLOAN
662 Hanna Bldg. Cleveland, Ohio

REBUILT POWER EQUIPMENT—Ready to Ship

ROTARY CONVERTERS

150 kw., West. 250 v. 1200 rpm., 2200 3 ph. 60 cy.
150 kva. G.E. 250 v. 1200 rpm., 440/3/60 type HCC.

MOTOR GENERATOR SETS

110 kw. Crocker Wheeler 250 v. 720 rpm., 2200/3/60 ind.
150 kw. Crocker Wheeler 250 v. 550 rpm., 2200/440/220 v. SYN.
150 kw. Crocker Wheeler 250 v. 600 rpm., 220/440 v. ind.
150 kw. Crocker Wheeler 250 v. 600 rpm., 220/440 v. syn.
125 kw. Crocker Wheeler 275 v. 900 rpm. 2300/3/60 Syn. 70% P.F.

ENGINE GENERATOR SETS

50 kw. West. 220/3/60 Ames Auto. Steam.
75 kw. G.E. 250 D.C. Skinner Uni. Steam.
100 kw. Fair Morse 2400/3/60 belted 2 cyl. DIESEL.
175 kw. G.E. 2200/3/60 dir. con. Ridg. STEAM.
175 kw. West. 2200/2/60 dir. con. Skinner Steam.
200 kva. Fair Morse 2400/3/60 dir. con. 4 cyl. DIESEL.
225 kw. Elec. Machy. 2300/3/60 Ideal 4 valve Steam.
300 kw. West. 250 v. D.C. Skinner Uniflow Steam.

D.C. GENERATORS—250 volt

30 kw. Allis Chal. 700 rpm.
80 kw. West. 265 rpm.
100 kw. G.E. 550 rpm.
150 kw. Crocker Wheeler 550 rpm.

100 HP. LIDGERWOOD HOIST

Double drum Speedwell 2500 lb. pull at 450' per min. direct driven by 100 hp. A.C. or D.C. Motor.

A.C. GENERATORS

219 kva. G.E. 2300/3/60 200 rpm, 80% P.F. (Can be reconnected 440 or 220 v.)
150 kva. Wagner 220/440 v. 3 ph. 60 cy. 600 rpm.
75 kw. G.E. 240/3/60 900 rpm. 80% P.F.

SPECIALS IN SLIPRING MOTORS 3ph. 60 cy.

HP	Make	Speed	Type
700	G.E.	393	MT-432
400	West.	1170	CW
300	G.E.	600	M
260	Burke	600	EM-65
250	G.E.	590	I-174
200	West.	690	CW-956A
100	West.	1750	CI

SYNCHRONOUS MOTOR

225 HP. G.E. 2200 v. 3 ph. 60 cy. 80% P.F. 200 rpm. (Can reconnect 440 or 220 v.)

TURBINE

1—Kerr Economy Steam Turbine 450 B.H.P. 3800 rpm. 5" intake, 12" exhaust with Kerr Reduction Unit 3800 to 720 rpm. 115 lbs. pres.

A.C. MOTORS—3 ph. 60 cy.

HP	Volts	Make	Type	Speed
800	2200	West.	Syn.	450
200	2200	G.E.	IK-15	1200
200	220/440	West.	CS	1200
200	220/440	West.	CS	720
200	220/440	West.	CS	600
225	2200	West.	CS	900
250	220/440	West.	CS	900
250	2200	West.	CS	1200
300	220/440	West.	CS	1150
300	2300	West.	CS	1200
300	2200/440/220	West.	CS	450
350	2200/440/220	West.	CS	450
400	2200/440/220	West.	CS	500
450	2200/440/220	West.	CS	600
500	2200/440/220	West.	CS	720
600	2200/440/220	West.	CS	900

CRANE MOTORS—230 V. D.C.

15 hp. Crocker Wheeler with electric brake 270 rpm
30 hp. Niles 650 rpm.
30 hp. Niles.
50 hp. West—38 B., 500 rpm.

GAS ENGINE GENERATOR SET

75 kw. West. 250 v. belted to 110 HP 2 cyl. Bessemer Gas Engine.

SPEED REDUCERS

23—3 to 5 HP. Thomas 2 speed ratio 1 side 100 to 1 other side 5 to 1.
5—10 HP. 600 At Cleveland ratio 90:1.
1—150 HP. R.D. Nuttal ratio 1.6:1.

TRANSFORMERS—1 ph. 60 cy.

1—100 kva. West. 2200-220/110.
2—75 kva. Burke 2200-110 v. 3 ph.
1—50 kva. Burke 2200-110 v. 3 ph.
2—50 kva. G.E. 2200-220/440 v.
3—37½ kva. West. 22000-2200.
6—10 kva. Pgh. 2200-220/110.

15 TON NILES CRANE—230 V. D.C.

31' span, lift 45 to 50', 3 motors.

DUQUESNE ELECTRIC & MFG. CO., Pittsburgh, Pa.

Get what you want IN A HURRY

from L. J. LAND & COMPANY, New York's Largest Stock of Electrical Equipment

A.C. EQUIPMENT

SYNCH. MOTORS

200 H.P. G.E. TS 514 RPM
90 H.P. Westinghouse 900 RPM
50 H.P. Elec. Mchy. 1200 RPM
47 H.P. West. 1200 RPM .7 PF

SLIPRING MOTORS

300 H.P. General Electric 720 RPM
200 H.P. General Electric 514 RPM
150 H.P. Allis Chalmers 720 RPM
2—125 H.P. G.E. 720 RPM
112 H.P. G.E. hoist 720 RPM
100 H.P. Fairbanks Morse 720 RPM
100 H.P. Allis Chalmers 720 RPM
100 H.P. Westinghouse 720 RPM
75 H.P. Westinghouse 1200 RPM
75 H.P. Allis Chalmers 600 RPM
60 H.P. Westinghouse 1200 RPM
60 H.P. General Electric 1200 RPM
60 H.P. General Electric 900 RPM
6 H.P. Westinghouse 300 RPM
4 H.P. GE. MT 900 RPM

SQUIRREL CAGE MOTORS

200 H.P. Allis Chalmers 1800 RPM
200 H.P. Allis Chalmers 1200 RPM
200 H.P. General Electric 600 RPM
150 H.P. Westinghouse 1800 RPM
100 H.P. G.E. 1200 RPM
100 H.P. General Electric 900 RPM
75 H.P. Westinghouse 900 RPM

A.C. GENERATORS

200 K.W. General Electric 600 RPM
125 KVA G.E. 900 RPM
100 KVA Crocker Wheeler 900 RPM
100 KVA Elec. Machy. 1200 RPM
75 KVA G.E. 1200 RPM
90 KW GE 900 RPM
15, 20, & 25 KVA 1200 RPM (8)

LOW & HIGH VOLT. GEN.

200 K.W. Wghse. 600 V. Mtr. Gen Set
2 to 40 K.W. 600 to 2000 V. M.G. Sets (11)
24 K.W. 60 V. General Electric
1 to 75 K.W. 10 to 80 V. (15)

100 KW Westinghouse Syn. MOTOR GENERATOR SET

Motor: 150 H.P. 3 ph. 60 c. 440 V 1200 RPM
Gen. 100 KW 250 Volt 1200 RPM—Complete AC & DC Control Equipment

30 HP Diehl Dynamometer DC 230 Volts 1500/3500 RPM Complete with Beam Scale Ball Bearing

3—48 CFM. Ingersoll Rand 125-lb. V Belt driven. New——immediate delivery.

3—667 KVA Gen. Elec. Late Type Transformers. 13800 v. Prim 230/460 v. sec. Good for indoor or outdoor service.

12½ x 12, 390' Amer. Air Comp.
14 x 10 Ingersoll Rand Air Comp.
1 Ton Shepard
15 to 50 K.W. Frequency Changers 90, 100, 120 cycle (7)
5 H.P. B & D D.C. Buffer Fans & Blowers (19)
Tirrell Voltage Regulators
165 KVA Arc Furnace Transformers

ONLY PARTIAL LISTING

New York City's Largest Stock Electrical Equipment

ONE YEAR GUARANTEE

L. J. LAND AND CO.

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Reading, Penna. Office: 12th and Spring St.
Over Quarter Century Serving Industry

D.C. EQUIPMENT

230 V. D.C. MOTOR GEN. SETS

100 K.W. West. 1200 RPM
75 K.W. Elect. Machy. 1200 RPM
50 K.W. Burke 1200 RPM
45 K.W. Westinghouse 700 RPM

125 V. M.G. SETS

2—150 K.W. Westingh. Syn. Motor
50 K.W. Crocker Wheeler
40 K.W. Westinghouse
35 K.W. Elec. Machy. Syn.
25 K.W. Gen. Elec.

230 V. D.C. MOTORS

75 H.P. General Electric 850 RPM
60 H.P. Sprague 900 RPM
60 H.P. G.E. 1000 RPM
60 H.P. Roth 600 RPM
50 H.P. G.E. 850 RPM
40 H.P. Reliance 825 RPM

330 V. VAR. SPEED MTR.

100 H.P. Crock. Wh. 550/900 RPM
75 H.P. Electro Dyn. 700/1050 RPM
35 H.P. West. 500/1500 RPM
30 H.P. West. 500/1500 RPM
30 H.P. G.E. 825/2000 RPM
25 H.P. G.E. CD 600/1200 RPM
15 H.P. G.E. RF 400/1200 RPM
15 H.P. West. .825/1650 RPM
15 H.P. G.E. 600/1800 RPM
15 H.P. Electro Dyn. 450/1350 RPM

115 VOLT D.C. MOTORS

90 H.P. General Electric 900 RPM
15 H.P. Eck 1500/1800 RPM
10 H.P. West. 1750 RPM

SEARCHLIGHT SECTION

SLIP RING MOTORS, 3 PH., 60-CY.

HP	Volts	Make	Speed
500	2300	Whse.	450
300	2300–4000	G.E.	1200
250	440–550	G.E.	600
200	2200–550	G.E.	1800
200	2200–440	G.E.	600
150	440–220	G.E.	1800
150	2200	G.E.	900
150	2200–440	Whse.	1800
150	550–2200	G.E.	1800
100	550–2200	G.E.	720
100	220–440	G.E.	720
100	440–220	G.E.	600
100	220–440	G.E.	900
80	220–440	G.E.-MTC	900
75	440–220	G.E.	900
75	220–440	G.E.	600
60	220–440	G.E.	720

SYNCHRONOUS MOTORS, 3-PH., 60-CY.

400	440–220	Whse.	276
350	440–220	G.E.	200
250	2300	G.E.	900
240	2300–440–220	G.E.	600
200	2300–4000	G.E.	1200
150	2200	G.E.	1800
100	440–220	G.E.	1200
50	220–440	G.E.	1200

TRANSFORMERS—60 CYCLE

3—400 kva., G.E. type H, 13200-440.
3—250 kva., G.E. type H-KD 23000-2300.
3—200 kva., G.E., H-KD 13200-2300.
3—200 kva., G.E. H-KD 6600-2300/4000Y., 25 cy.
1—100 kva., Pittsburgh, type OISC 2400-240-120.
3—200 kva., G.E., type H-KD, 13800-230/460.
2—150 kva., Whse. 4800/4156/2400-480/240.
3—100 kva., G.E. type H, 2300-230/115.
3—100 kva., Whse type, SK, 2300-230/115
3—100 kva., G.E., type H-KDD, 6900/11950Y-230/115.
3— 50 kva., G.E. type H-K 2300-230/115.
3— 50 kva., Pittsburgh, 13800-240/120.
3— 50 kva., Moloney, 2300-230/115.
6— 50 kva., Whse type SK, 13800-240/120.
3—37½ kva., G.E., type H-K 2200-460.
3—37½ kva., G.E., type H-K, 2300-230/115.
3— 25 kva., G.E., type H-K 2300-230/460.
3—25 kva., Whse type S 2300-575
3— 25 kva., G.E., type H-KR, 6900-230/460.

A. C. GENERATORS

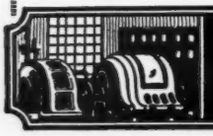
1—500 KVA, 900 r.p.m. 2200 V. Whse. Condenser.
1—312 kva., 900 r.p.m., 2300-V., Westghse.
1—300 kva., 600 r.p.m., 240-480-V., G.E.
1—225 kva., 600 r.p.m., 2200-240-480-V., G.E.
1—219 KVA, 200 r.p.m., 480 V. Whse.
1—187 kva., 900 r.p.m., 2200-550-V., Westghse.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	1200
500	440/220	G.E.	IK	900
400	2200	Whse.	C.S.	1800
300	2300/440	G.E.	IE-K	1200
250	2200	G.E.	IE-K	1800
250	2200	G.E.	I-K	600
200	220/440	G.E.	IK	720
200	2200	G.E.	IK	720
150	2200	Allis Ch.	AN	450
100	2200	G.E.	IK	600
100	2200	G.E.	IE-K	1800
100	550	G.E.	KT	900
100	220/440	G.E.	KT	720
75	2200	G.E.	KT	900
75	2300	G.E.	IE-K	1800
50	220/440	G.E	K	1800

MOTOR GENERATORS SETS

1—100 K.W., 250 V., 1200 R.P.M. Ridgeway, con. to 150 H.P., 2200 V., 3 ph., 60 cy., syn. motor.
1—60 K.W., 125 V., 1200 R.P.M. GE, type RC to 90 H.P., 4150/2300 V., 3 ph., 60 cy. syn.
1—25 K.W., 125 V., 1800 R.P.M., G.E., con. to KT 40 H.P., 2200/440 V., 3 ph., 60 cy. motor
1—GE, 3 unit set, consisting of 1 type RC, 10 KW, 250 V., 1750 RPM, and 1 RC, 10 KW, 125 V. Generators, coupled to KT, 35 H.P., 220/440 V., 3 ph., 60 cy., SC motor.



STEPHEN HALL & COMPANY, INC.

458 Seventh St., Hoboken, N. J.

FREQUENCY CHANGER

1—100 KW, 60/100 cy., Gen. Elec., type ITT-553, secondary volts 375, secondary amps. 190, to a 60 HP, 3 ph., 60 cy., 440/220 V., 1200 rpm, type KT-526 motor; standard Gen. Elec. unit. No accessories.

MOTOR GENERATOR SETS

1—150 KW, 275 V., 900 rpm, type SK, Westgh. to a 225 HP, 3 ph., 60 cy., 230 V., unity P.F., Westgh. syn. motor with A.C. and D.C. panels.
1—300 KW, 275 V., 720 rpm, General Elec., type MPC, to a 430 HP, 3 ph., 60 cy., 2300 V., ATI, Gen. Elec. syn. motor with A.C. and D.C. panels.
1—300 KW, 600 V., 695 rpm., Allis-Chalmers to a 450 HP, 3 ph., 60 cy., 2300 V., 690 rpm, induction motor.

TURBO GENERATORS

1—937 KVA, 750 KW, 3 ph., 60 cy., 2300 V., 3600 rpm, Gen. Elec. complete with C. H. Wheeler surface condenser, pumps, radojet.

The above are just a few of the thousands of items we have in Motors, Generators, Turbo Generators, Engine Generators, Motor Generators, Transformers, Circuit Breakers, etc. Please send us your inquiries. What have you for sale?

GEORGE SACHSENMAIER CO.

8403 Hegerman St. Phila, Pa.

SYNCHRONOUS CONVERTERS

300 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM
200 KW WEST. 250 D.C. 2300/4000 A.C. 1200 RPM
200 KW Al-Ch. 250 D.C. 2300/4000 A.C. 1200 RPM
200 KW R.W. 250 D.C. 2300/4000 A.C. 1200 RPM
150 KW R.W. 250 D.C. 2300/4000 A.C. 1200 RPM

SYNCH. MOTOR GENERATORS

215 KW Al-Ch. 250 V. 2300/4000 A.C. 1200 RPM
150 KW R.W. 250 V. 2300 A.C. 900 RPM
100 KW WEST. 250 V. 2300 A.C. 900 RPM

IND. MOTOR GENERATORS

300 KW G.E. 250 V. 440 A.C. 720 RPM
200 KW G.E. 250 V. 440 A.C. 720 RPM

Each unit listed above is owned by us and is Available now for immediate purchase.

WALLACE E. KIRK CO.

Incorporated

502 Grant Building Pittsburgh, Pa.

7½ KW. West. turbo-gen. 250 V. 4000RPM. #9901, type 45E, Price $525.00

with two 20" Ohio magnets, 250 V. DC, wth contactor for magnets and a steel frame for cable support. Price each... $300.00

1—450 HP. GE. I-M. 2200/60/3/1800 RPM., with control

1—400 HP. GE. I-P 2200/60/3/257 RPM. with control

ELECTRIC EQUIPMENT COMPANY

P. O. Box 51 Rochester, N. Y.

FOR SALE

DIESEL ENGINE

450 H.P. Bessemer Solid injection Full Diesel Engine, 225 R.P.M., 4 Cylinder, 4 Cycle, 15" Bore x 22" Stroke, Tex Rope Drive to 300 K.W. G.E. Generator, 3 Phase, 60 Cycle, 2300 volt with Switchboard and G.E. Tyrell Voltage Regulator.

ALJON ELECTRIC DIESEL CO.

151-5 Washington St. Brooklyn, N. Y.
Main 4-3804-5

COMPLETE POWER PLANTS

For Immediate Shipment

2000 KW TURBO-GENERATOR

Westinghouse 2857 KVA @ 70% P.F. with 3000 Sq. Ft. Surface Condenser

Also—1500 KW Turbo Non-Condensing

back pressure up to 30#

CHARLES B. REARICK 30 CHURCH ST., NEW YORK

TRANSFORMERS

A new Lot of Reconditioned Transformers acquired—200KVA and down. Let us have your inquiries.

Electric Apparatus Repair Co.

Specialists on Rebuilding Motors, Generators and Controls

1410 No. 6th St., PHILA., PA.

150 KVA G. E. Gen Dir Con Ex. 325 RPM. Coupled to 3 cyl Worthington Full Diesel A-1.

125 KVA G. E. Gen Dir Con Ex. 720 RPM. Coupled to 6 cyl Gasolene or Nat Gas Engine, Like New.

Paul Jay Electrical Machinery Corporation

70-76 Atlantic Ave. Brooklyn, New York

Available immediate delivery

SKINNER UNAFLOW ENGINE direct connected 75 KVA Generator 3/60/220 exciter panel and voltage regulator.

ALSO FITCHBURG PISTON VALVE ENGINE direct connected Burke generator 2/60/220.

MANHATTAN BOILER & EQUIPMENT CO.

80 Water St. New York City

300 KW ROTARY CONVERTERS

1—300 KW Burke Rotary Converter, 250 volts D.C., rolled steel frame, 6 phase, 60 cycles with transformer and swbds.
1—300 KW Westinghouse Rotary Converter, 600 volts D.C. 6 ph. 60 cy., pedestal bearings, 1200 RPM.

TRANSFORMERS

3—200 kva Moloney Type HE Transformers, single phase, 60 cycles, 2200/4400-240/480 volts. Also from 1 kva to 750 kva sizes in stock.

75 KW MOTOR GENERATOR SET

1—75 KW GECo Induction MG Set, 250 V-DC. 3-60-220/440 V-AC, 1200 RPM, with switchboard.

ELECTRIC EQUIPMENT FOR INDUSTRY

WRITE FOR STOCK LIST ON

CONSTANT SPEED MOTORS D.C.
ADJUSTABLE SPEED MOTORS D.C.
MILL & CRANE MOTORS D.C.
SQ. CAGE & SLIP RING MOTORS A.C.
SYNCHRONOUS MOTORS A.C.
TRANSFORMERS

CRANE MOTORS

1—MDS 109½, 1—MC90, 2—38-B, 1—CO 1812, 1—MDS 108, 1—CO 2007, 3—CO 2004, 2—12A, 1—48.

MILL MOTOR

1—Type MCOB Frame 80 Westghse, 230 volt, back geared, 130 HP, 430 RPM, ¼ hour to 75 HP, 500 RPM, 1 hour.

ELECTRIC FURNACE

1—300# Detroit Electric Furnace, Type LFA for 440 volts A.C. Used 6 months.

150 KW MOTOR GENERATOR SETS

2—150 KW Gen. Electric Synch. Motor Generator Sets 500 volts D.C., 3-60-2300 volts A.C. with swbds.

FREQUENCY CHANGERS — TURBO GENERATORS — AC & DC MANUAL MAGNETIC CONTROL — CENTRIFUGAL PUMPS — AC & DC SWITCHBOARDS

FOR DETAILS, WRITE: **JOHN D. CRAWBUCK CO.** 406-7 EMPIRE BLDG. PITTSBURGH, PENNA.

SLIP RING MOTORS

Three Phase, Sixty Cycle, 220/440 Volts

1							
1— 5	H.P.	MT 181	1200 RPM	3—40	H.P.	CW	900 RPM
1— 7½	H.P.		1800 RPM	1—40	H.P.	MT	1200 RPM
1— 7½	H.P.	IM	900 RPM	3—35	H.P.	I—M	900 RPM
1— 7½	H.P.	HI—M	900 RPM	3—40	H.P.	MT	900 RPM
1—10	H.P.	F	900 RPM	2—35	H.P.	CI	690 RPM Crane
1— 7½	H.P.	CI	680 RPM Crane	1—50	H.P.	CW	1200 RPM
1— 7½	H.P.	CI	1200 RPM Crane	1—50	H.P.	Allis	1200 RPM
3— 7½	H.P.	CW	690 RPM	1—40	H.P.	Allis	435 RPM
1—10	H.P.	MT	900 RPM	3—50	H.P.	CW	900 RPM
3—10	H.P.	MT	1200 RPM	2—50	H.P.	MT	900 RPM
1—10	H.P.	I—M	1200 RPM	4—50	H.P.	CW	680 RPM
1—10	H.P.	I—M	900 RPM	4—50	H.P.	MT	600 RPM
1— 7½	H.P.	CW	900 RPM	1—50	H.P.	MT	680 RPM
1—10	H.P.	Wagner	1200 RPM	3—75	H.P.	CW	600 RPM
1—10	H.P.	CW	1200 RPM	2—75	H.P.	CW	900 RPM
2—15	H.P.	MW	800 RPM	2—75	H.P.	I—M	1200 RPM
4—15	H.P.	CW	900 RPM	2—75	H.P.	I—M	900 RPM
1—15	H.P.	CW	690 RPM	3—75	H.P.	MT	900 RPM
1—20	H.P.	MT	900 RPM	4—75	H.P.	MT	600 RPM
1—20	H.P.	CW	600 RPM	2—75	H.P.	ITC	900 RPM Crane
1—20	H.P.	Wagner	600 RPM	3—100	H.P.	I—M	600 RPM
1—25	H.P.	CW	1200 RPM	1—100	H.P.	HF	1200 RPM
4—25	H.P.	HF	1200 RPM	1—150	H.P.	HF	600 RPM
4—25	H.P.	CW	900 RPM	1—150	H.P.	ITC	680 RPM Crane
2—25	H.P.	CW	690 RPM	1—125	H.P.	I—M	680 RPM
3—25	H.P.	CW	600 RPM	3—100	H.P.	CW	600 RPM
2—25	H.P.	I—M	600 RPM	1—100	H.P.	CW	900 RPM
1—25	H.P.	MT	1200 RPM	1—100	H.P.	MT	900 RPM
1—30	H.P.	I—M	1200 RPM	1—100	H.P.	MTC	900 RPM Crane
4—30	H.P.	Wagner	540 RPM Crane	2—200	H.P.	CI	600 RPM Crane
1—30	H.P.	CW	900 RPM	2—150	H.P.	CW	600 RPM
3—30	H.P.	CW	1200 RPM	2—125	H.P.	CW	600 RPM
2—30	H.P.	Allis	900 RPM	1—300	H.P.	I—M	900 RPM
2—30	H.P.	MT	900 RPM	1—300	H.P.	MT	900
1—30	H.P.	MT	1200 RPM	1—400	H.P.	CW	1200
2—20	H.P.	MTC	1200 RPM	1—200	H.P.	I—M	600
1—25	H.P.	I—M	680 RPM				
3—30	H.P.	Imperial	900 RPM				
—40	H.P.	CI	690 RPM New Crane				
2—40	H.P.	MTC	900 RPM Crane				
1—40	H.P.	Star	900 RPM Ball bear.				

Hand control can be furnished for nearly all above and automatic for a large number

SLIP RING MOTORS

3 phase, 60 cycle, 2300 volts

—40	H.P.	CW	900 RPM	1—100 H.P.	HF	1200 RPM
—200	H.P.	I—M	600 RPM	2— 50 H.P.	MT	600 RPM
— 50	H.P.	CW	1200 RPM			

SQUIRREL CAGE MOTORS

3 phase, 60 cycle, 230/400 volts

2— 50	H.P.	CS	900 RPM
4— 50	H.P.	KT	1800 RPM
2— 50	H.P.	CS	1200 RPM
2— 50	H.P.	KT	1200 RPM
2— 60	H.P.	KT	3600 RPM
2— 60	H.P.	KT	1800 RPM
1— 60	H.P.	KT	900 RPM
1— 50	H.P.	I—K	490 RPM 3 bear.
1— 50	H.P.	KT	600 RPM
1— 60	H.P.	KT	680 RPM
2— 60	H.P.	CS	3600 RPM
2— 75	H.P.	KT	1200 RPM
1— 75	H.P.	Allis	1800 RPM
1— 75	H.P.	Allis	1200 RPM
2— 75	H.P.	CS	900 RPM
1— 75	H.P.	KT	900 RPM
2— 75	H.P.	I—K	680 RPM
2— 75	H.P.	I—K	600 RPM
2— 75	H.P.	CS	600 RPM
4—100	H.P.	KT	1800 RPM
2—100	H.P.	KT	1200 RPM
2—100	H.P.	KT	910 RPM
1—100	H.P.	I—K	600 RPM
1—150	H.P.	Allis	1800 RPM
1—150	H.P.	CS	1200 RPM
3—150	H.P.	IEK	1200 RPM
1—150	H.P.	I—K	700 RPM
1—100	H.P.	KTP	1200 RPM
1—200	H.P.	CS	1750 RPM
3—200	H.P.	I—K	1750 RPM
3—200	H.P.	IE—K	1200 RPM
1—250	H.P.	CS	900 RPM
1—300	H.P.	Allis	900 RPM

230 Volts Constant Speed D.C.

4— 1	H.P.	CD	1180 RPM
9— 2	H.P.	CD	1725 RPM
5— 2	H.P.	CD	1180 RPM
9— 2	H.P.	SK	850 RPM
16— 3	H.P.	SK	1150 RPM
21— 3½	H.P.	SK	850 RPM
9— 5	H.P.	SK	1750 RPM
23— 5	H.P.	SK	1150 RPM
19— 5	H.P.	SK	850 RPM
7— 7½	H.P.	SK	1750 RPM
21— 7½	H.P.	SK	1150 RPM
16— 7½	H.P.	SK	850 RPM
11—10	H.P.	SK	1750 RPM
7—10	H.P.	SK	1150 RPM
12—10	H.P.	SK	850 RPM
9—15	H.P.	SK	1150 RPM
8—15	H.P.	SK	850 RPM
4—20	H.P.	SK	1750 RPM
7—20	H.P.	SK	1150 RPM
4—20	H.P.	SK	850 RPM
4—25	H.P.	SK	1750 RPM
4—25	H.P.	SK	1150 RPM
4—25	H.P.	SK	850 RPM
2—30	H.P.	SK	1750 RPM
1—30	H.P.	SK	1150 RPM
1—30	H.P.	SK	975 RPM
2—40	H.P.	SK	1750 RPM
2—40	H.P.	SK	1150 RPM
2—50	H.P.	SK	1750 RPM
2—75	H.P.	SK	1750 RPM
1—75	H.P.	SK	460 RPM

Many other makes and ratings available in D.C. motors. Several fans, hoists, pumps, transformers, motor-generator sets and miscellaneous items in Scranton stock.

Hand and automatic starters available for most of the above

PENN ELECTRICAL ENGINEERING COMPANY

SCRANTON, PA. **TELEPHONE 8175-6-7-8**

Re-built Motors and Generators

2—75 HP, 2200 V, **Fairbanks Morse,** 1800 RPM, 3 PH, 60 CY slip ring motor, direct connected to 500 GPM 3 stage 300' head pump.

1—400 HP **Westinghouse,** type CW, 3 PH, 60 CY, 440 V, 450 RPM slip ring motor.

3—350 HP **Allis Chalmers,** 3 PH, 60 CY, 440 V, 600 RPM slip ring.

1—300 HP **Allis Chalmers,** 3 PH, 25 CY, 440 V, 485 RPM slip ring.

2—250 HP **Westinghouse,** type CS1012, 3 PH, 60 CY, 440 V, 435 RPM sq. cage.

1—200 HP **Westinghouse** syn. 1 PF, 3 PH, 60 CY, 2200 V 600 RPM with direct connected exciter, 3 or 2 bearing.

2—150 HP **Allis Chalmers,** 3 PH, 60 CY, 440 V, 450 RPM slip ring.

2—150 HP **Westinghouse,** type CW, frame 1000, 2 PH, 60 CY, 440 V, 450 RPM slip ring.

2—100 HP **Westinghouse,** type CS, frame 754 C, 3 PH, 60 CY, 440 V, 870 RPM sq. cage.

3—150 HP **Allis Chalmers,** 3 PH, 60 CY, 440 V, 1750 RPM sq. cage.

1—100 HP **Westinghouse,** type CCL, 3 PH, 60 CY, 2200 V, 1750 RPM sq. cage.

1—100 HP **Wagner,** type 26V5BP, 3 PH, 60 CY, 440 V, 860 RPM sq. cage

2—100 HP **Allis Chalmers,** type ANY, 3 PH, 60 CY, 440 V, 690 RPM slip ring.

1—100 HP **Westinghouse,** type SK, frame 160, 230 V, 1100 RPM.

1—100 HP **Allis Chalmers,** type ANY, 3 PH, 60 CY, 2200 V, 690 RPM slip ring.

1—75 HP **Allis Chalmers,** 3 PH, 60 CY, 440 V, 450 RPM slip ring.

1—75 HP **Westinghouse,** type CW, 3 PH, 60 CY, 440 V, 720 RPM slip ring, 3 or 2 bearing.

1—75 HP **Fairbanks Morse,** type H, frame 165 C, 3 PH, 60 CY, 550 V, 900 RPM sq. cage.

2—75 HP, **General Electric,** type I, 3 PH, 60 CY, 220 V, 720 RPM sq. cage.

1—75 HP, **General Electric,** type MT, frame 337, 220 V, 3-60-1745 RPM.

1—75 HP **Lincoln,** type IQ, 2 PH, 60 CY, 440 V, 600 RPM sq. cage.

1—75 HP **Finn-Weiksel (Wagner)** ty. 26VRN, 3 PH, 60 CY, 220 V, 1200 RPM syn.

1—250 HP **Crocker Wheeler,** type CCM, size 151 H, 230 V, 600 RPM, DC

3—100 HP **General Electric,** type CD, frame 123, 230 V, 1200 RPM DC

1—60 HP **General Electric,** type CD, frame 115, 230 V, 850 RPM, DC

1—50 HP **Westinghouse,** type SK, frame 160, 230 V, DC, 565 RPM

1—50 HP **General Electric,** Class 6, Form B, 600 V, DC, 600 RPM

1—50 HP **Ideal,** type SMS, 3 PH, 60 CY, 220 V, 1800 RPM, synchronous.

1—60 HP **Westinghouse,** type SK, frame 160, 230 V, DC, 680 RPM

1—60 HP **C&C,** 230 V, DC, 250/1000 RPM

1—75 HP **General Electric,** type CD, frame 176, 550 V, DC, 250/1000 RPM

3—75 HP **Westinghouse,** type SK, frame 150, 230 V, DC, 1100 RPM

1—100 KW **General Electric,** type DLC, 125 V, DC, 440 V, AC M-G set.

1—60 KW **General Electric,** type DLC, 150 V, DC, 220 V, AC M-G set

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1— 500 KW. GE. 2300 V. Mixed P.
1— 500 KW. GE. 600 V. Cond.
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1—1190 Cu. Ft.—IR—2 stage Direct Motor
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1—1730 Cu. Ft.—Chic. Direct motor drive.
1—782 Cu. Ft.—IR—55#.
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1— 167 H.P. HRT—150#
1— 60 H.P. HRT—125#

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1—4000 GPM, DeLaval Cent. 195 Ft. Head Driven by 300 H.P. G.E., 2200 V. motor
1—1500 GPM, DeLaval Cent. 290 Ft. Head Driven by 200 H.P. G.E., 2200 V. motor
1—1500 GPM, Gould Fire Pump, 231 Ft. Head Driven by 150 H.P. G.E., 2200 V. motor
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HP	Make	Volts	Speed
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225	Ideal (Unity P.F.)	440	900
1-175	Westgh. .8 P. F.	2200	600
2- 75	G.E.	2200	900
75	Westgh.	220	1800

SLIP RING & SQ. CG. MOTORS (3 ph. 60 cy.)

HP	Make	Speed	Wdg.	Type
700	G.E.	393	S.R.	MT432
400	G.E.	257	S.R.	MT
200	Cr. Wh.	440	S.R.	28
200	G.E.	700	S.R.	I M
200	Al. Ch.	600	S.C.	
150	West.	720	S.C.	CS
125	Al. Ch.	435	S.R.	
100	Lincoln	1200	S.C.	
100	F. M.	600	S.C.	BB
75	G.E.	690	S.R.	I M
75	West.	575	S.R.	CW868A

DC VARIABLE MOTORS (230 VOLTS)

HP	Type	Make	Speed
75	SK	Westgh.	475/1425
20	SK	Westgh.	900/1800
10	SK	Westgh.	600/1200
5	SK	Westgh.	450/1800
2	SK	Westgh.	500/1800

300 HP D.C. VARIABLE SPEED MOTOR

Westgh. 230 v. 250/500 RPM interpole #8099644

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219 KVA G.E. TRE 2400/480/240 v. 3 ph. 60 cy. 200 RPM with exc.
200 KVA G.E. Type ATB 2200/440/220, 720 RPM, 3 brg.

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846 cu. ft. 65# Ing. Rand 2 stage ERI
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355 cu. ft. 100# Laidlow Dunn
160 cu. ft. Chic. Pneu. 100#
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20 Ton AC Whiting 46' span, fish belly girders equipped with three motors, 220 or 440 v. 3 ph. 60 cy. cab control.

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2—400 H.P., 160#, 4 drum, bent tube, pulverizers.
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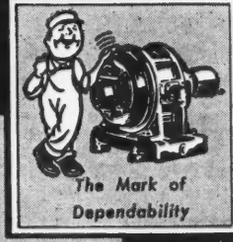

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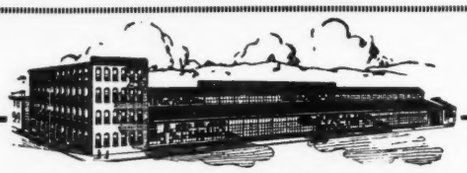

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2—100 HP, 1200 RPM, Type 26V

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1—125 HP, 720 RPM, Type 31V
4—150 HP, 900 RPM, Type 31V

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3—500 KW General Electric, 600 volts, D.C., direct connected to 700 HP, 720 RPM, 2500/5000 volts, 3 phase, 60 cycle Synchronous Motor with direct connected exciters.

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1—125 KW, 125 volt, 250 RPM, Westinghouse Generator connected to a 15" x 16" Skinner Automatic Engine.

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250 K.W. Vilter Corliss 150#
Engine Generator Set 550 Volt D. C.
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1—17x21" Lentz Poppet Valve Steam Engine, direct connected to 200 KVA Allis Chalmers Electric Generator, complete with Exciter.

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One (1) Single Retort Underfeed Stoker, Motor Driven, 6' 0" long x 5' 6" wide, equipped with Forced Draft Fan and Automatic Controls. Perfect condition. Ready of immediate shipment. Inquire of

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3—333 KVA-GE-Outdoor Type Transformers—22000 Vpri.—11000 Sec. Excellent Condition on original foundations.

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General Electric Synchronous Motor

75 HP—Frame 5556—Type T.S. Form P.K. —600 R.P.M. 220 volts, 3 phase, 60 cycle with Direct Connected Exciter, Serial # 431208 complete with Starting Equipment.

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1—600 HP **B&W boilers**, 200# pres.
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1—250 HP. **Erie City Economic** 150 lb. pressure.

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5—180 HP **Fairbanks-Morse** Model 35, Oil Engines, new in 1935.
1—84" x 125' self-supporting **steel stack.**
1—**Cochrane feedwater heater**, 90,000# per hr., 10# pressure.

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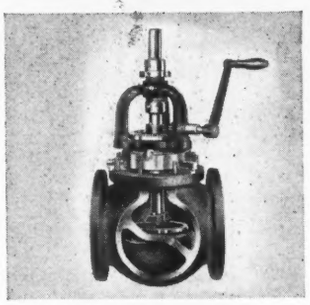
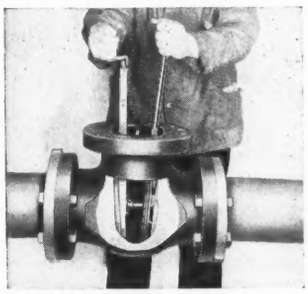
STOP LEAKAGE LOSSES
REDUCE MAINTENANCE COSTS
KEEP PRESENT VALVES IN SERVICE
AVOID SHUT DOWN

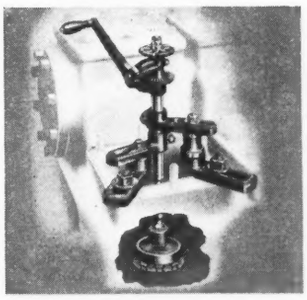
. . . that's what DEXTER VALVE RESEATING EQUIPMENT will do for YOU!



Dexter Globe Valve Reseating Machine



Dexter Gate Valve Reseating Machine



Dexter Pump Valve Reseating Outfit

Available for Globe, Gate and Pump Valves . . . and QUICKLY Pays for Itself

The job of keeping your plant in continuous operation—of avoiding delays waiting for repair parts—of making savings all along the line which will contribute to the demand for greater and greater power output—can be vastly simplified by reconditioning your valves with DEXTER VALVE RESEATING EQUIPMENT.

Every valve in your plant can be given a new lease on life and made leak-proof quickly, easily, and at low cost the Dexter way because Dexter Equipment is available for all types of valves—Gate, Globe and Pump.

Now is the time to put Dexter Equipment to work—equipment which pays for itself over and over again through making valves last longer and through eliminating the dollars and horse power wasted through leaking valves. You may not be able to get new valves or replacement parts quickly but you *can* get Dexter Equipment. Write at once for complete information.

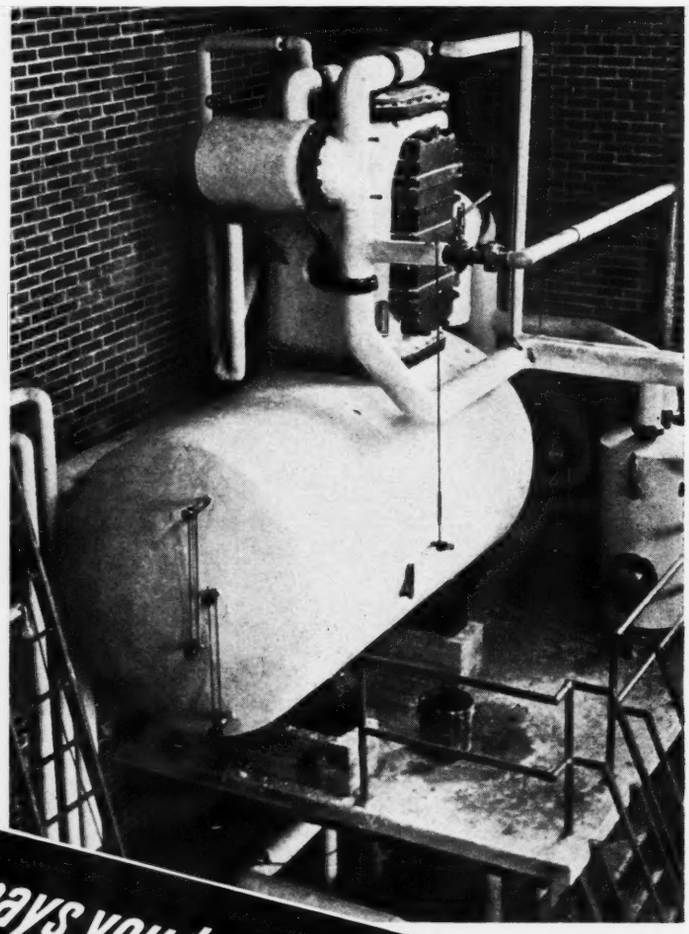
A FEW TIPS ON HOW TO MAKE YOUR VALVES LAST LONGER

Inspect valves regularly.
RESEAT, REGRIND VALVES as soon as they leak with DEXTER EQUIPMENT.
Don't force improperly seated valves—RESEAT them the DEXTER way.
Clean valves and pipe lines before installing valves; keep valves closed during installation.
Cut pipe threads to proper length; use compound on pipe not in valve.
Use hand wheel for opening and closing valves — not bars or wrenches.
Open and close valves slowly.

THE 32-PAGE DEXTER CATALOG
Contains Specific, Helpful Information On Valve Maintenance.

Sent FREE on Request

The LEAVITT MACHINE CO.
ORANGE, MASS.



It pays you to get this slant on Feed Water Heating

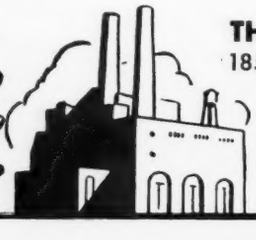
Swartwout Equipment delivers oxygen-free water exceeding the guarantee — helps reduce power costs

YOU TAKE ANOTHER time-and-cost-saving step when you supply adequate preheating, deaerating and purifying facilities for your boiler feed water. For you eliminate much of the costly boiler cleaning, the efficiency-killing corrosion and excessive fuel consumption. Swartwout Feed Water Heaters make unusual records every day in hundreds of plants—exceed the guaranteed oxygen removal and assure definite savings. • Heater at left above handles 30,000 lbs. of water per hour at 40° initial, stores 2½ minutes supply at maximum load. Oxygen tests by disinterested engineers register "no trace." Installation at right tested out equally well, handling 40,000 lbs. per hour at an initial 45°. Copper bearing steel storage tank has 151 cubic feet capacity. Leak-proof machined joint helps make this a life-time unit. (Photographed after four years of service). No rumble or noise, although load fluctuates widely. • Swartwout guarantees completely satisfactory performance. Heaters are engineered to fit your needs. Write for Bulletin S-18-D and describe your conditions. No obligation!

Feed Water Regulators • Pump Governors • Feed Water Heaters
Master Controls • Reducing Valves • Separators • Exhaust Heads

Swartwout

•Power Plant Equipment•



THE SWARTWOUT COMPANY
18501 Euclid Avenue • Cleveland, Ohio

* * *

Controlled **AIR CIRCULATION**
for Power Plants and Industrial Buildings

Down goes "Down-Time"-66%

1000 EXTRA HOURS BETWEEN SHUTDOWNS *with* SOLNUS OILS

"Down-time" is lost time. Reduce "down-time" and you save that most vital of war-time needs—power!

Here's a diesel owner who cut "down-time" two-thirds—actually eliminated two out of every three shutdowns for inspection and carbon cleaning—by changing to SOLNUS OILS for diesel lubrication. His former trouble of piston rings breaking has entirely vanished . . . and engine maintenance costs have dropped sharply.

Add your plant to the many that are already getting peak diesel performance . . . and stepped-up production . . . by using SOLNUS OILS, the modern diesel oils that are

- **Wholly Distilled**
- **Low in Carbon Content**
- **Neutral in Acidity**
- **Durable**

Call in a Sun Oil Engineer—one of those famous "Doctors of Industry"—for specific recommendations on how to get improved performance from your diesels. Write or wire

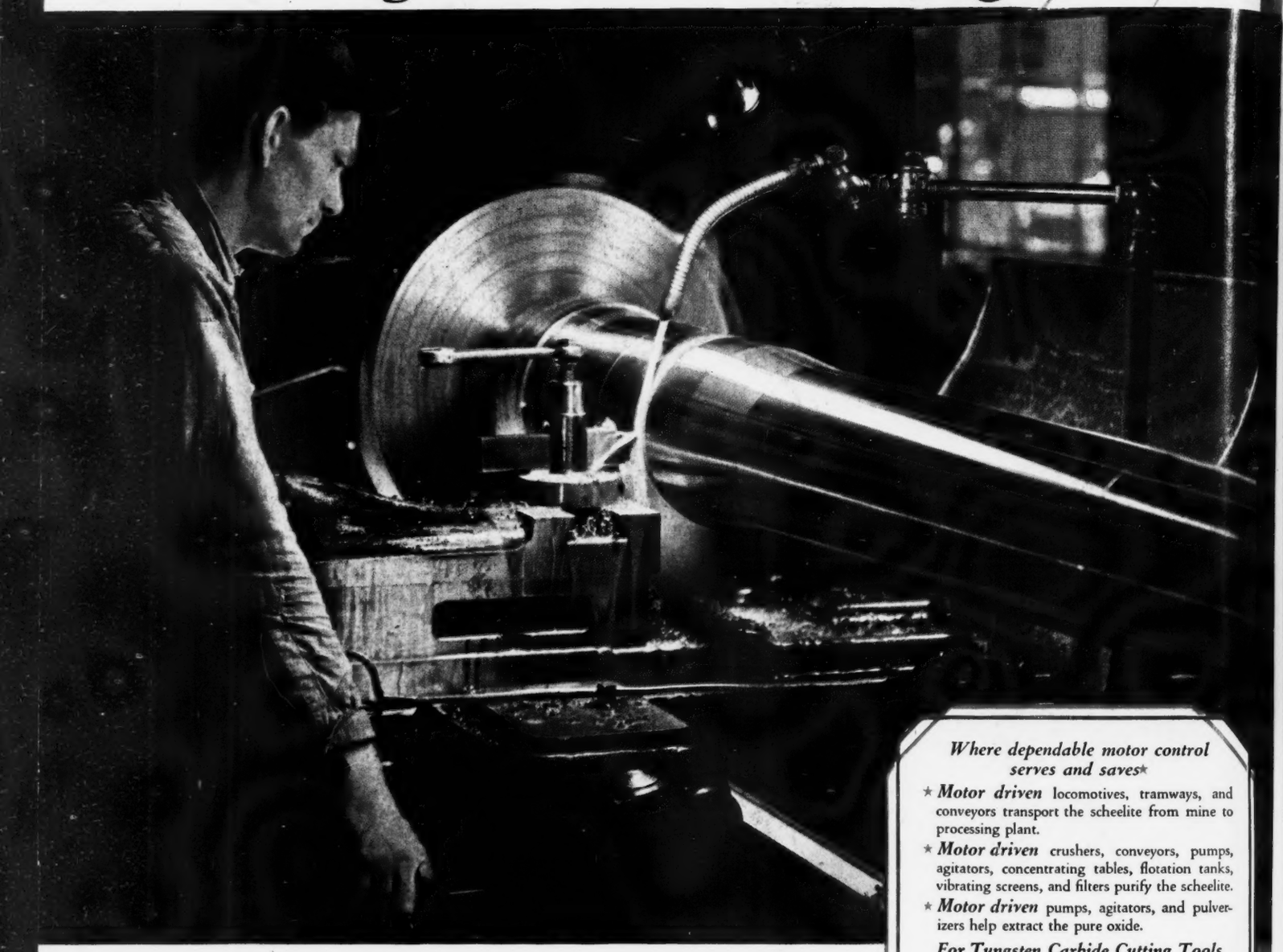
SUN OIL COMPANY • PHILADELPHIA

LET'S GO! U.S.A. KEEP 'EM FLYING!

SUNOCO

SUN PETROLEUM PRODUCTS HELPING INDUSTRY HELP AMERICA

Tungsten Makes It Tough



Tungsten hardens steel but also makes it tough on Motor Control

Dust, corrosive fumes, humid air and heat make the mining of *any* metal the toughest test of endurance that can be imposed on man, machine or motor control. But in the case of tungsten with its high specific gravity, its high melting point and the diamond hardness it imparts to its alloys, the going is tough all the way through. That's why you find Cutler-Hammer Motor Control standing guard over motor-driven machines at every step of the way...in the mining of this critical metal...in its reduction and recovery... and especially where tungsten tooled millers, grinders, cutters, broaching machines and hones are working day and night at the toughest tasks to be found in all of America's gigantic victory effort. The times demand unfailing dependability in men, machines, and motor control alike. And the times are discovering it in fullest measure, in Cutler-Hammer Motor Control. CUTLER-HAMMER, Inc., 1358 St. Paul Avenue, Milwaukee, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto.

1892-1942

CUTLER·HAMMER
MOTOR CONTROL
C·H

50th ANNIVERSARY

Where dependable motor control serves and saves★

★ ***Motor driven*** locomotives, tramways, and conveyors transport the scheelite from mine to processing plant.

★ ***Motor driven*** crushers, conveyors, pumps, agitators, concentrating tables, flotation tanks, vibrating screens, and filters purify the scheelite.

★ ***Motor driven*** pumps, agitators, and pulverizers help extract the pure oxide.

For Tungsten Carbide Cutting Tools

★ ***Motor driven*** conveyors carry the oxide through electric reduction furnaces.

★ ***Motor driven*** hydrogen blowers protect the reduction.

★ ***Motor driven*** ball mills combine tungsten and lampblack.

★ ***Motor driven*** furnaces, crushers, rotary screens produce the tungsten carbide.

★ ***Motor driven*** mixers, pulverizers, and screens mix tungsten carbide with cobalt.

★ ***Motor driven*** presses shape the rough cutting tool tips.

★ ***Motor driven*** conveyors carry the rough tips through continous sintering furnaces.

★ ***Motor driven*** grinders, polishers, milling machines, and forges prepare and finish the carbide tipped tools.

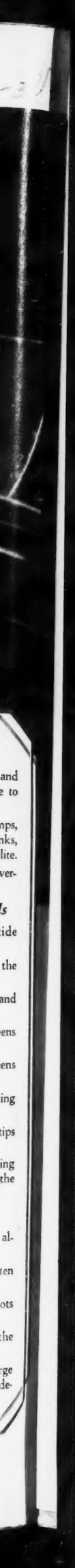
For Tungsten Steel Cutting Tools

★ ***Motor driven*** machinery feeds the electric alloying furnaces.

★ ***Motor driven*** cranes pour the ferro-tungsten alloy ingots.

★ ***Motor driven*** forges cog the alloy steel ingots into billets.

★ ***Motor driven*** rolling mills shape and size the tool stock.

★ ***Motor driven*** machines cut, grind and forge the tools for thousands of ★ motor driven defense production machines.

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